DOCUMENT RESUME

ED 115 481　　　　　　　　　　　　　　　　　　SE 019 744

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TITLE　　Environmental Knowledge and Beliefs among Grade 10 Students in Australia.
PUB DATE　　17 Sep 75
NOTE　　156p.; Ph.D. Dissertation, Oregon State University; Occasional small type used in appendices. A few pages may not be legible when reproduced

EDRS PRICE　　MF-$0.76 HC-$8.24 Plus Postage
DESCRIPTORS　　*Attitudes; Beliefs; Doctoral Theses; *Educational Research; *Environment; Environmental Education; Evaluation; Grade 10; *Knowledge Level; *Secondary School Students; Surveys
IDENTIFIERS　　*Australia; Research Reports

ABSTRACT

To develop environmental education in Australia, a survey of tenth-grade students was undertaken. Thirty knowledge items and ten belief items were constructed. A panel of environmentalists and educators identified best responses for the knowledge items, and a common reference point, preservation of homo sapiens, for the belief items, so a composite attitude measure was obtainable. SMOG grading was employed to insure grade 10 readability. A total of 30 students, in 174 schools in 6 Australian states, comprised the sample population. On 10 of 20 items, 50 percent or more students selected the best alternative, with greatest knowledge in the area of population. Misunderstandings occurred in resource use, pollution, and radiation. In 6 of 9 belief items, 50 percent or more agreed with preservation of homo sapiens, supporting statements about individual rights. Catholic schools were less in favor of family planning; females supported this issue. Metropolitan students were more aware of pollution, and residential students of traffic accidents. A .28 correlation existed between knowledge and belief items--significant, considering sample size. Australian students appeared as knowledgeable as their American counterparts, but deficiencies and misunderstandings are evident. (BP)

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Environmental Knowledge and Beliefs among Grade 10 Students in Australia

by

Vivian George Eyers

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

Completed September 17, 1975

Commencement June 1976

SE 019 744

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Date thesis is presented September 17, 1975

Typed by Mary Jo Stratton for Vivian George Eyers

ACKNOWLEDGEMENTS

I am indebted to the many schools and their students who cooperated so readily in this study, and to the Directors of Education in the Australian States for their support.

Special thanks are due to:

Dr. Fred Fox and Dr. Stanley Williamson, for their guidance, stimulation, inspiration and - most of all - for empathy and friendship;

my other committee members, and to the faculty and staff of the Science Education Department at this University for providing all those things which a graduate student needs;

Dr. Arthur Lucas and Dr. Effie Best in South Australia, for their advice, criticism and practical assistance;

Dr. Robert Howe, for suggestions, cooperation and the use of marvellous facilities;

my family members, for their various and unique contributions to a long drawn-out affair;

the senior administrators of the Education Department of South Australia for their kindly support and their willingness to provide leave of absence.

TABLE OF CONTENTS

Page

I. INTRODUCTION 1

- The Need for Environmental Education 2
- The Nature of Environmental Education Programs 4
- Environmental Education in Australia 6
- The Need for the Study 8
- The Problem 11
- Definition of Terms 12
- Hypotheses 15
- Assumptions 16
- Design of the Study: An Outline 16
- Limitations 19

II. REVIEW OF LITERATURE 21

- An Overview of Evaluation in Environmental Education 22
- Literature Relating Directly to the Study 23
- Literature Relating to the Educational Significance of the Findings of a Baseline Study 31

III. THE DESIGN OF THE STUDY 42

- The Instrument 43
- The Population 49
- The Sample 51
- Administrative and Data Collection Procedures 59
- Analysis of Data 61

IV. ANALYSIS OF DATA 63

- Sampling Returns and Distributions 64
- Knowledge Section 66
- Beliefs Section 83
- Comparisons between Item Responses to Corresponding Items by Grade 10 Students in Australia and the USA 95
- Analysis of Variance 97
- Correlations 99

Page

Factor Analysis 105
Alternative Second Stage Sampling Procedures 105
Summary 106

V. SUMMARY, INTERPRETATIONS, CONCLUSIONS AND RECOMMENDATIONS 107

A Summary of the Study 107
Some Interpretations and Explanations of Individual Results 114
Conclusions 120
Recommendations for Further Study 125

BIBLIOGRAPHY 129

APPENDICES

Appendix I. The Instrument 134

Appendix II. Data Collection Material 137

Appendix III. The "Preservation of *homo sapiens*" Scale 142

LIST OF TABLES

Table		Page
3.1	Number of Students in Grades, by States, 1972.	50
3.2	Stage One Sample, Number and Distribution of Schools, by State.	58
4.1	Sampling Returns by States: Schools Invited, Schools Responded, and Students.	65
4.2	Second Stage Sample: Frequency of Three Alternative Methods, as % of Total Sample.	66
4.3	Item Analysis, Section A, "Knowledge."	67
4.4	Frequency of Response to Item A30, "Source of Environmental Knowledge," by State, School Type, Region and Sex.	74
4.5	Frequency of "Best Answer" Responses to Knowledge Items A1-29 by State, School Type, Region, Sex, and Source of Knowledge.	76
4.6	Item Analysis, Section B, "Beliefs."	84
4.7	Frequency of Response to Belief Items B1-9 by State, School Type, Region, Sex, and Source of Knowledge.	87
4.8	Frequency of Response to Item B10, "Local Problems," by State, School Type, Region, Sex, and Source of Knowledge.	94
4.10	Analysis of Variance, Raw Total Scores, Knowledge and Belief Sections.	98
4.11	Frequency of Positive Correlation of Knowledge Items with Other Knowledge Items, and Belief Items.	101

4.12 Frequency of Correlation of Belief Items with Other Belief Items, and Knowledge Items. 101

4.13 Frequency of Correlation of item A30 Alternatives with Knowledge Items, and Belief Items. 102

4.14 Correlations: A Total with B Items. 103

4.15 Correlations: B Total with A Items. 103

4.16 Correlations: "Source of Knowledge" Responses with Total Scores. 104

5.1 Rejection of H_o, Total Score Basis. 114

LIST OF FIGURES

Figure		Page
4.1	Frequency of Response, Total Sample by Knowledge Item Groups.	68
4.2	Frequency of Response, Total Sample by Belief Item Groups.	85
4.3	Histogram, Total Belief Scores.	92

AN ABSTRACT OF THE THESIS OF

Vivian George Eyers for the degree of Doctor of Philosophy

in Education presented on September 17, 1975

Title: ENVIRONMENTAL KNOWLEDGE AND BELIEFS AMONG GRADE TEN STUDENTS IN AUSTRALIA

Abstract approved: ______________________________
Fred W. Fox

The purpose of the study was to survey aspects of environmental knowledge and beliefs among Grade 10 students in Australia, in the belief that such information would be useful for workers in the developing field of environmental education there.

A survey instrument prepared and used for a similar purpose in the USA was used in the study, after adaptation to suit the Australian situation. The new instrument contained 40 items in two areas called "knowledge" and "beliefs." One of the 30 items in the knowledge section was designed to trace the major source of student information about the environment, while one of the 10 belief items concerned perceived local problems. Best responses were identified for each of the 29 multiple choice knowledge items, while a selected panel of environmentalists and educators provided a common reference point for the nine remaining belief items, so that a composite attitude measure could be obtained. This reference point was that of an attitude favoring the preservation of homo sapiens.

In modifying the original instrument, the SMOG grading was used to ensure that the readability of the final instrument was at the Grade 10 level.

From a two-stage sampling method in which the first stage (secondary schools) was drawn with a probability proportional to size, 174 schools were asked to each provide 30 students who would complete the instrument. Within each of the six Australian states, all school types (Government, Catholic and Independent) were represented in the proportion of their Grade 10 populations.

The collected student responses were analyzed by standard computer programs, with comparisons being made with respect to the independent variables of state of residence, school type, region (metropolitan or not), sex and membership of a self-identified group derived from responses to the "major source of environmental knowledge" item.

For item by item comparisons, chi-square measures were used to investigate hypotheses that the frequency of correct knowledge responses, or of agree-with-panel belief responses was the same for each group within the independently variable sample populations. In an attempt to avoid spurious significances, and to emphasize practical differences, a confidence level of 0.001 was chosen.

Analysis of variance procedures were applied to the means of total knowledge and total attitude scores. The same confidence level was used again.

Findings

Of the 174 schools approached, 160 or 92% replied positively, providing the responses of 4821 students.

A general examination of the responses revealed a number of areas of knowledge inadequacy. The composite attitude displayed was one which could be regarded as supportive of measures designed to preserve the species homo sapiens. Responses to several items suggested that such positive and general attitudes might not be stable when individual conveniences or freedoms were threatened.

On an item by item basis, most differences in response were associated with state of residence, with sex and with membership of one of the self-identified "source of knowledge" groups.

When total scores were considered, differences in the knowledge section were associated with sex and "source of knowledge." Males gave superior responses to those from females in this section. In the attitude section, differences were associated with school type, region and with knowledge source, but not with sex.

Responses to the "source of information" item indicate that as far as these students are concerned, schools are not yet providing them with special environmental education courses which supply the major component of their knowledge about environmental matters. On the other hand, the very positive response of the schools to the study is taken as an indicator that Australian secondary schools have a high degree of interest in gaining information which could be useful to them in future environmental education programming.

ENVIRONMENTAL KNOWLEDGE AND BELIEFS AMONG GRADE 10 STUDENTS IN AUSTRALIA

I. INTRODUCTION

The recent emergence of a widespread consciousness about the deteriorating quality of the human environment has been followed by a call for the schools to provide programs of Environmental Education. Because of the rapidly increasing interest in such programs, and because of the likely implementation of an Australian National Environmental Education Project, this study surveyed current knowledge and attitudes about general environmental matters among Grade 10 students in Australia.

In Chapter I, a brief resume of the origin and nature of the demand for Environmental Education[1] programs is followed by an account of the scope of these programs and the extent of their implementation in a number of countries. A recent proposal for a National Environmental Education Plan of Action in Australia is described, together with a statement of a perceived need for a baseline study of current Environmental knowledge and attitude patterns among Grade 10 students there.

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[1] The lengthy term "environmental education" is used so frequently in this study, that an abbreviated form E-E is sometimes used where grammatical requirements permit, especially where the term has to be used in close sequence.

Hypotheses, working definitions and an outline of a research design for such a study follow.

The Need for Environmental Education

In 1916, no less a liberal humanitarian than John Dewey remarked upon the desirability of "playing freely upon the subjugation of the world for human ends" (p. 136). This widely accepted view that man could subjugate the world for his own ends has undergone a drastic re-evaluation now that the consequences of such activities have become evident. During the last decade, an environmental consciousness has developed, both described and fanned by voluminous literature; popular, scientific and governmental.[2] The following extract from the Documents for the U.N. Conference on the Human Environment (Stockholm, 1972) summarizes and describes this new consciousness:

> We see around us growing evidence of man-made harm in many regions of the earth; dangerous levels of pollution in water, air, earth and living things; major and undesirable disturbances to the ecological balance of the biosphere; destruction and depletion of irreplaceable resources; and gross deficiencies in the

---

[2] Widely cited references include: Rachel Carson, Silent Spring (Boston: Houghton Mifflin, 1962); Paul R. Ehrlich, The Population Bomb (New York: Ballantine, 1971); Donella Meadows et al., The Limits to Growth (New York: Universe Books, 1972, 1974); and Jeremy Evans and Stephen Boyden (eds.), Education and the Environmental Crisis (Canberra: Australian Academy of Science, 1970).

man-made environment of human settlements (U.S. Dept. of State, 1972).

The problems described in this statement are taken so seriously that a growing body of scientific opinion now sees the redressing of this imbalance as the most important task facing humanity (Meadows, 1974, p. 193). Whether or not various governments see such a task as the most important one facing them, there has nevertheless been considerable legislative activity expressing concern, a degree of responsibility and some commitment for action. (Examples include the U.S. National Environmental Policy Act of 1969, and the Environmental Protection Acts of Victoria, Australia, 1970, and of South Australia, 1972.)

In addition to the economic, technical and legal effects of such legislation, there has been a substantial movement toward providing programs of environmental education. These programs have appeared in both formal and non-formal educational settings. In Australia, for example, more than 200 agencies have been identified as being involved with environmental education in some form (Australian Conservation Foundation, 1974). The extent of the importance attached to educational programs is illustrated by a statement from the 1972 U.N. Conference in Stockholm; "Education and training are vital to the long term success of environmental policies" (U.S. Dept. of State, 1972b). The Introduction to the Environmental Education Act of the U.S. Congress (1970) recommended that every phase of education be reordered so as to bring about ecological understanding, while in Australia at a conference sponsored by the Australian Academy of Science, Frankel (1970) expressed the view that for the coming decades, environmental education was "the most pressing and important aspect of education."

One result of the 1972 U.N. Stockholm Conference is that UNESCO has been charged with specific leadership responsibility at the international level. In January, 1975, a three-year environmental education project was approved (Stapp, 1975).

The Nature of Environmental Education Programs

In an attempt to list the environmental education programs which have proliferated in the last few years in the USA as a response to the encouragement described in the previous section, a number of collations and classifications of these programs has been made (e.g. Helgeson *et al.*, 1971; Rocchio and Lee, 1973). Working from such sources, Lucas (1972) and Linke (1974a) have analyzed the general nature of environmental education programs and the way in which some of the key terms are used.

Lucas noted basic confusions and differences in the use of the term "the environment." While the common assumption was that the referent for the environment was human, in some cases the referent appeared to be the individual human, in others some demographic group (e.g., Americans) and in others the species homo sapiens. Depending on the referent position taken, different stances concerning relevant conservation and education programs were likely to be taken. Where such referent differences were not made clear, difficulties in communication between environmental conservation proponents tended to appear. For example, Lucas attributed the "acrimony" in the debates between Ehrlich and Commoner[3] to the assumption of a homo sapiens referent viewpoint on one hand, and that of the individual human on the other. A further complication was perceived to arise from the common usage of the term "the environment." In many cases studied, the user applied a limitation, so selecting those parts of the total human environment (the Universe) which had relevance and interest to the user at that time. However, such limitations tended to be implied rather than stated.

From an analysis of the literature concerning E-E programs, Lucas decided that in its common use, the term E-E referred to one or more of the following primary classes:

Education about the environment--facts, concepts, principles;

Education for the environment--attitudes and skills directed to conservation;

Education in the environment--forms of outdoor education.

---

[3] In "A Bulletin Dialogue," Bulletin of the Atomic Scientists 28; 5. May 1972, p. 17.

A conclusion was reached that while many programs specified the first two goals, most had the emphasis of being for the environment.

From a list of widely used and accepted definitions, Linke (1974) extracted a "common core of essential characteristics" of E-E, from which a model for the goals E-E was then developed:

1. An awareness of the interrelation between man and the environment;
2. A concern for the quality of life;
3. A commitment to environmental conservation (p. 21).

A close relationship between his model and the primary classes proposed by Lucas was noted.

Both models propose or imply the development of attitudes favorable to environmental conservation. References in the literature to the need to develop such attitude patterns were noted so frequently that Linke concluded that this emphasis placed environmental education in the unique position of being more characterized by attitudinal goals than by cognitive ones.

Environmental Education in Australia

In 1973-74, Linke obtained federal funding "to examine the current status of Environmental Education in Australia, and to compare this with overseas trends, with a view to providing some rational basis for directing and coordinating future developments in this area." Countries included in the study were the USA, the U.K., the USSR, Canada, Sweden and Australia. The highest degree of support for environmental education was noted in the USA, where hundreds of programs had been documented, and where a considerable emphasis had been placed on teacher education. In Australia, although numerous organizations were found to be involved in some aspect of environmental education, these activities were uncoordinated. In the schools, many teachers had initiated programs in this area, but no major comprehensive efforts had appeared. In a summary of the international situation, Linke remarked upon the generally uncoordinated nature of the approaches and the general lack of agreement about relevant (instructional) objectives. Hopefully, the new UNESCO project will help to overcome some of these deficiencies.

For Part II of the survey, an analysis of the nature and extent of environmental education in Australia was undertaken (Linke, 1974b). Four techniques were used: (1) an analysis of relevant documentation; (2) a mailed questionnaire to schools and their teachers; (3) personal interviews with educators; and (4) the development and application of a system of content analysis to relevant curriculum materials. Of 373 elementary and secondary schools approached, 99 replied. Among the respondent teachers, many were found to lack a clear model for environmental education, attributing to it a big range of characteristics which Linke called "inappropriate." A content analysis of newspaper, radio and television programs indicated a low level of environmental content. Similarly, a representative sample of curriculum materials showed little environmental content, especially in science materials. Even those science curriculum materials developed from outlines specifying environmental goals were found to be deficient in actual content in this area.

In December, 1974, the Federal Minister for Education in Australia set up a special committee of the national Curriculum Development Centre (Spring, 1975). The committee was required to survey the field of environmental education in Australia so as to identify needs and to suggest ways in which the Curriculum Development Centre could act to meet these needs. An "Action Plan for Environmental Education" was proposed by the committee with a budget of some $2 million over a three-year period. With a primary thrust toward teacher education, the Plan provided for Regional Consultants, a National Information Centre, local Information and Field Study areas, and the establishment of teams for materials development and for evaluation.

The Need for the Study

There is such interest in environmental education that the proliferation of these programs can be expected to continue, even if the Australian federal government does not fund the Project recommended by the Curriculum Development Centre. A usefully coordinated approach to E-E could be achieved in Australia, where centralized organization of education still exists. But to achieve this coordination, basic curriculum decisions need to be taken. Some of these include:

1. What definitions and usages are appropriate for the terms environment, the environment and environmental education? What referent for "environment" should be used?
2. Should E-E programs be about the environment, or for the environment, or be in it?
3. Should E-E be provided in the form of separate courses of study, or should a transdisciplinary approach be used, in which E-E is merged with other courses of study?
4. What age-range of students should be attended to? (In Australia the school population falls dramatically after Grade 10. Should the full thrust of school-based E-E programs be completed by this grade?)
5. What course goals should be specified? Which of these can and should be expressed in behavioral terms?
6. What means of achieving these goals are appropriate?
7. What evaluation procedures should be applied to both the student outcomes and to the E-E programs themselves?

These are fundamental questions, but a simple, practical and prior question needs to be asked. "What do students already know and believe about environmental matters?" While this question is always of relevance in curriculum development, it takes on new importance in environmental education. In this area, unlike the situation in (say) arithmetic or chemistry, the matter of education for or about the environment has clearly not just been left to the schools. Governments, public and private agencies have all been involved, not to mention the possible effects of the value positions taken by the families of the students. It may be that the non-formal educational activities of such interested parties have already established in the target students the very attitudes (say) which formal E-E programs might set out to develop. Prior information about general environmental knowledge and attitude structures seems of real importance, especially in a situation in which coordinated or national curriculum planning is contemplated. The formulation, the posing, and the analysis of responses to this prior question is the basis of this present study.

An opportunity to make use of a relevant E-E evaluative instrument developed at The Ohio State University for use in a rather similar nationwide study in the USA provided an added impetus, for it opened up some interesting international implications. While environmental concerns are global in nature, the related activities and attitudes of the people of the USA are of unusual importance. The USA accommodates about 6% of the world population, yet reportedly consumes some 40-50% of the natural resources consumed in the world each day (Ehrlich and Ehrlich, 1972). No other country can afford to disregard the environmental activities and attitudes of a consumer of this magnitude. A series of studies currently underway in the USA seeks to gauge the general environmental knowledge and attitude patterns among Grade 10 and Grade 12 students there (Perkes, 1973). Consequently, there seemed to be additional value in carrying out a parallel study in Australia, so that comparisons across corresponding student groups might be made.

Linke (1974, p. 111) has referred to a dearth of empirical research of this nature. Since The Ohio State studies do address themselves to this relatively vacant field, the extension of an assessment of general environmental knowledge and beliefs to Australia seems appropriate, given the international nature of the problems.

The Problem

In view of the need for Environmental Education in Australia, and considering the current status of E-E there, an important beginning question and the fundamental problem underlying this study is: "What kinds of knowledge and beliefs do Australian students have about the environment, and about environmental issues?"

Questions Related to the Problem

Specific questions relating to the general statement of the problem are as follows.

1. What is meant by the term "environment ?"
2. What areas of knowledge about, and beliefs and attitudes toward this environment are relevant to the study?
3. What student population is appropriate for study?
4. How can this population be properly sampled?
5. How can relevant data be obtained from this sample?
6. What analyses can and should be applied to these data?
7. What conclusions can be drawn?
8. What subsequent recommendations and suggestions can be made?

For a non-funded researcher working on such a general problem in an ongoing school system there are other questions. How can such a study be carried out efficiently and economically? How can a high degree of cooperation be obtained from the large number of schools likely to be involved? Indeed, one measure of the need for such a study, as perceived by the schools themselves, could be taken to be the extent of their voluntary participation in the study.

Definition of Terms

The Environment

Taking the individual human as the referent for "the environment," and the maintenance of that human's well-being as the purpose for an interest in the environment, then those parts of the total environment (the Universe) which can be regarded as making up the environment can be identified if they satisfy three criteria.

1. The individual's well-being is potentially affected by the component.
2. Exposure to the component is inevitable.
3. The exposure is random and unintentional (Lucas, 1972).

The utility of taking this position in the present study is that it provides a rationale for item selection in the preparation of the survey instrument; e.g., some of the items in an instrument designed for USA students could refer to a version of "the environment" not appropriate for students in Australia. In addition, by acknowledging the existence of different and legitimate referents for the environment (e.g., the individual vs. homo sapiens), polar reference positions become available for the consideration of attitudes toward the environment.

Environmental Education

For the purposes of this study it will be accepted that

> Environmental education is an integrated process which deals with man's inter-relationships with his natural and man-made surroundings, including the relation of population growth, pollution, resource allocation and depletion, conservation, technology and urban and rural planning to the total human environment. Environmental education is a study of the factors influencing ecosystems, mental and physical health, living and working conditions, decaying cities and population pressures. Environmental education is intended

> to promote among citizens the awareness and understanding of the environment, our relationship to it, and the concern and responsible action necessary to assure our survival and to improve the quality of life (Environmental Education Act, U.S.A., 1970).

Such a definition is taken to include "conservation education."

Attitudes and Beliefs

Fishbein and Ajzen (1975) provide a stipulative definition of "attitude" as "the amount of affect for or against some object." At the same time they recognize that

> Most investigators would probably agree with a description (or definition) of attitude as a learned disposition to respond in a consistently favorable or unfavorable manner with respect to a given object (p. 6).

While noting that beliefs, opinions and attitudes are sometimes used as synonymous terms, Fishbein and Ajzen make the distinction that "a person's attitude toward an object is based on his salient beliefs about that object."

In this study, the use of the term "Your Beliefs" as the heading for the attitude section (Part B) of an evaluation instrument administered to students is in the sense of "Is it your belief that . . . ?"

The position is then taken that a summation of a number of "strength of belief" statements concerning designated environmental issues can be used as an indicator of a general attitude toward the preservation of the species homo sapiens.

Hypotheses

Knowledge Areas

There are no significant relationships between areas of environmental knowledge as measured by the instrument to be used and

1. the Australian state of residence of the students;
2. the nature of the Australian school system, whether
    a. Government,
    b. Catholic, or
    c. Independent;
3. geographic location, whether
    a. metropolitan, or
    b. non-metropolitan;
4. sex;
5. the source of that knowledge, as proposed by the students responding to the instrument;

Beliefs about Environmental Issues

There are no significant relationships between environmental beliefs as recorded by the instrument and those strata listed under Knowledge Areas above.

Assumptions

Assumptions relating to the study were:

1. There was a need to obtain relevant information about the environmental knowledge and attitudes of Grade 10 students in Australia.
2. That this information could be obtained by using a survey instrument mailed to the schools.
3. That a survey instrument devised and used in the USA could be successfully adapted and used in Australia.
4. That a sample of Grade 10 students could be obtained which would be representative of the population of Grade 10 students in the various strata of schools in Australia.

Design of the Study: An Outline

The Instrument

The instrument prepared for and used in the Ohio State studies formed the basis for this study. The three parallel forms of that instrument were consolidated into one form containing 40 items;

30 in the "knowledge" area concerning matters of population growth, pollution and the use of resources, together with 10 items concerned with beliefs and attitudes about environmental issues. Where needed, items were adapted to suit the Australian situation. Attention was paid to the readability of the instrument to ensure that it was appropriate for Grade 10 students. Two local trials of the developing instrument were given. Test-retest procedures were used to establish instrument reliability.

The Population

The target population contained all students in the 10th grade in the secondary schools of the six states of Australia. These schools are Government, Catholic and Independent. The Grade 10 levels in the USA study (the other was Grade 12), and because it represents the final year of formal schooling for many students in Australia.

The source of population data was a listing held by the Australian Council for Educational Research (ACER), having been established for a Science evaluation project in 1970. It was the most recent listing available.

The Sample

A series of two-stage stratified probability samples was drawn from this population data, one set from each state. Stage 1 consisted of a sample of schools drawn with a probability proportional to their size. Stage 2 was a series of samples of about 30 students drawn by the selected schools from among their Grade 10 students.

The size of the Stage 1 sample drawn in each state was calculated after a system devised by Peaker, and used in the IEA study in 1970 (Rosier, 1973). This calculation acknowledges the clustering effect produced by the use of schools as the primary sampling unit rather than randomly chosen students drawn from the whole population. Intraclass correlations on the knowledge areas of the instrument as determined during the second trial were used in the calculation.

Data Collection Procedures

A single approach mailed survey technique was used. Since all but the Independent schools operate within each state through centralized administrative groups, the approval of the respective State Directors of Education was obtained before any approaches were made to the schools.

A mailing package was prepared for each school containing:

1. a letter to the principal of the school explaining the purpose and nature of the study, and asking for cooperation;

2. a supply of the instrument forms;
3. instructions and suggestions for the sampling of the students, and for administering the instrument; and
4. a coded, addressed envelope for the return of the responses to the instrument (designed as a small detachable section of the instrument itself to minimize handling problems).

Since the success of the study depended largely upon the voluntary cooperation of the schools at a busy time of the year, the greatest care was taken with the design, wording and practicality of the materials in this package.

Analysis of the Data

The coded school information and the student responses in each returned package was punched on computer cards, and analyzed by a combination of statistical computer packages. For the "beliefs" section, a "preservation of homo sapiens" scale was established, from the responses provided by a group of environmentalists and educators in South Australia who were asked to respond to that section of the instrument from such a preservation viewpoint. The student responses were compared by strata.

Limitations

1. The measured environmental knowledge and attitudes of

Australian students will be limited to those revealed by the survey instrument used.

2. Observations or conclusions made about the environmental knowledge and attitudes of Australian students, and about environmental education in Australia will be based on information revealed by the 1974 Grade 10 students in Australia.
3. Students in the two Australian territories are excluded from the study because of sampling considerations.
4. Only those schools and students represented in the 1970 ACER sampling frames are included.

II. REVIEW OF LITERATURE

The present study takes the form of a general survey of environmental knowledge and of attitudes toward certain issues related with the environment. Its purpose is to reveal areas of knowledge or ignorance, and patterns of affect toward environmental conservation which will be of use to curriculum workers and to others interested in environmental education in Australia. As the discussion in Chapter I has shown, and as the analysis of data to be discussed in Chapters IV and V will reinforce, E-E is in its infancy in Australia. There have been no previous evaluative studies of this present nature in Australia. The brief review of literature which follows has as its goal the placement of the study within the conceptual framework of other evaluative studies in E-E, and the location and elucidation of those research findings which bear upon the areas of the findings from this study.

The general organization of the chapter is as follows.

1. An overview of the different categories under which evaluation of E-E has been reported in the literature, together with the citing of typical or key references.
2. An identification of those aspects of the literature relating directly to this study, with an analysis of the findings described in those reports.

3. An analysis of generalized and specific findings which have a bearing on the uses to which the findings of this particular study might be put.

An Overview of Evaluation in Environmental Education

The burgeoning literature on E-E now contains many studies relating to evaluation. Their general scope includes:

1. reminders or exhortations about the necessity of evaluation in E-E (e.g., Stapp, 1973, for H.E.W.);
2. general plans for the evaluation of E-E programs (e.g., Rocchio and Lee, 1973);
3. examples of self-evaluation instruments which could be used by administrators and teachers (e.g., Gargasz, 1973);
4. specific but transferable plans for monitoring the effectiveness of program materials in meeting stated goals (e.g., Bennett, 1974);
5. descriptions of the preparation and use of evaluative instruments, usually to measure attitudes toward the environment or toward environmental issues (e.g., Hoover and Schutz, 1963b; Steiner and Barnhart, 1972; DeLucia and Parker, 1974);
6. studies measuring any attitude and/or knowledge change as a result of specific courses in E-E (e.g., Bowman, 1974);

7. surveys of environmental knowledge, opinions and attitudes among large adult populations (e.g., Spaulding, 1969); and

[illegible]. baseline or preliminary studies of knowledge and attitude patterns among students who have not yet had significant school-based E-E experiences (e.g., Perkes, 1973).

Of these categories, numbers 5, 7 and 8 seem of the most direct relevance to this study.

Literature Relating Directly to the Study

Baseline Studies of Environmental Knowledge and Attitudes

There is a dearth of such studies, and only two will be reported.

Reference was made to Perkes (1973) in Chapter I. It contains the first report of a three-part general survey of environmental knowledge and attitudes among Grade 10 and Grade 12 students in the USA. The data for the study were collected from five Great Lake States and six Far Western States, where a sample of 199 schools representing 30.4% of the number of schools in the sample design was obtained. The instrument was prepared by the staff of the ERIC Clearinghouse for Science, Mathematics and Environmental Education at The Ohio State University with assistance from selected consultants, and contains three forms of an inventory requiring responses to verbal items ranging over specific facts about the environment, general environmental concepts and attitudes about certain aspects of the environment. The three basic environmental issues of population control, pollution and the extent and usage of resources were included. There was no attempt to arrive at a total attitude scale, means were not calculated, and only item by item reports were made.

An examination of the responses to the knowledge section revealed a number of areas in which student knowledge was not high. As far as general attitudes were concerned, Perkes concluded that where these attitudes were broad in nature and involved little personal commitment then they tended to be favorable (to environmental conservation). But in specific cases, such general attitudes did not tend always to be transferred intact into the new situation. It was observed that males scored significantly higher than females on "fact" items, but not on general concepts. While a statistical difference by sex appeared in some items of the attitude section, the differences were regarded as having little practical significance. When grade levels were considered, Grade 12 students scored better than Grade 10 students on matters of environmental concepts but not on facts. Again, a statistical but not a practical difference appeared in the attitude section. Community size was found not to be related to environmental facts and concepts, but was related to several attitude items dealing with local environmental concerns. Concerns about pollution problems increased as the size of the community increased, until a level of population of 100, 000 was reached, when concern fell.

Two other related studies from The Ohio State University covered the remaining regions of the USA, and used the same instrument. In these studies, yet to be published, relationships between knowledge and attitudes are to be explored.

Hounshell and Liggett (1973) administered an Environmental Knowledge and Opinion Survey instrument to a random sample of 1, 881 Grade 6 students in nine school systems in North Carolina. The instrument contained 35 knowledge items and 30 attitude items. Total scores in each section were calculated, and the t-test used to determine whether significant differences existed between the responses of males and females, and between urban and rural students. A correlation coefficient (r) was calculated to compare student scores on the two subtests. Overall means were 14. 3 (of 35) for the knowledge subtest, and 16. 4 (of 30) for attitude.

Girls scored higher than boys on the attitude section (significant at the 0. 001 level), but there was no significant difference between the two on the knowledge scale. Knowledge score means for the urban students were higher than for those for rural students (at the 0. 05 level), but no significant difference existed between their attitude means. A positive correlation (0. 6, significant at the 0. 01

level) was reported to exist between total scores on the knowledge and the attitude subtests, encouraging Hounshell and Liggett to postulate that the development of constructive environmental attitudes could be achieved by providing students with well-structured environmental knowledge.

A study reported in a general analysis of research on attitudes about environmental issues by Knapp (1972) has bearing on a question which could be raised about the general importance of research about the attitudes of such young children as those in the study considered above. Knapp reported a study of 17,000 elementary students in the USA by Hess and Torney. These researchers claimed that while changes in (political) attitudes occur as age increases, that a substantial degree of attitude formation had occurred by the end of the fifth grade.

Studies Measuring Environmental Attitudes and/or Knowledge, Using Relatively Small Numbers of Respondents

Hoover and Schutz (1963a, b) first prepared an attitude instrument of 32 Likert-type items, and administered it on a trial basis to a group of college science majors. Factor analysis of the results produced 10 clear factors, but a number of the items were factorially complex. In an attempt to clarify the apparently multi-dimensional nature of the conservation attitudes so revealed, a new instrument was prepared in which the new items were designed to relate specifically to only one of the previously isolated factors. After applying this new instrument to 104 science majors and science teachers, the use of a cluster analysis technique revealed 16 clusters of items, of which the first three had K-R reliability coefficients greater than 0.7. The authors identified the items in these three clusters as respectively characterizing "Assistance for the Common Good," "Regulations for the Common Good" and "Private Rights versus Conservation." It was felt that "pervasive value systems" were indicated as determinants of conservation behavior.

Cohen (73) and Cohen and Hollingsworth (73) set out to study relationships between the amount of environmental information possessed by students and their environmental attitudes. A 70 item questionnaire containing equal numbers of knowledge and attitude items was administered to 454 high school students in 7 schools. A 17 item subtest within the instrument was used as an indicator of environmental knowledge; an overall mean of 6.24 being reported. The student responses were ranked on their scores on this subtest, and then divided into Low, Middle and High Environmental Content (E-C) groups. The responses of the High and Low groups to the other items on the instrument were compared. The researchers found that the Low E-C groups appeared to be making serious attempts to answer correctly the remaining environmental knowledge questions, but that they revealed major misconceptions (e.g. about the source of atmospheric pollution). Such misconceptions were felt to be illustrative of the kind of information which should be provided in E-E courses. Those students in the High E-C group, as measured by the sub-test used, tended to have more positive environmental attitudes, and were more prepared to express these attitudes in definite form. It was observed that the High E-C group contained significantly more males than females, even though the numbers of each in the sample were about equal. The authors offered the suggestion that many of the responses by the Low E-C students could indicate that they had not advanced beyond the Piagetian concrete operational level of intellectual development. While the suggestion that research on the imparting of environmental information should consider the 'processing ability' of the students seems useful, the researchers do not comment upon the implication that since the Low E-C group in their study consisted predominantly of females, that females were being regarded as having undergone less intellectual development than males of similar chronological age.

After constructing a 28 item questionnaire from a list of 28 "controversial topics" proposed by Garrett Hardin in relation to human population growth, Stronck (1972) administered the instrument to 27 teachers and 493 high school students. From his analysis of the responses, Stronck concluded that attitudes became more positive as grade level increased, and that in most cases the sex of the respondent had no effect on opinion. However, in one item dealing with policies toward zero population growth, Grade 12 girls did favor such policies more strongly than did the general student group. The responses to several of the items encouraged Stronck to remark that the students seemed to be resistant to educational programs which might change their attitudes.

Bart (1972) developed an attitude measure from 20 positive ecological attitude statements extracted from the literature of such conservation groups as The Sierra Club. The items provided Yes-No alternatives. A volunteer group of 100 graduate education students were asked to respond "in an honest manner" to the 20 items. Following the coding of positive ecological responses as 1, and others as 0, an ordering theory analysis was applied to the data. Seven attitude groups were produced by this process, each group being in the form of a hierarchy, leading Bart to the conclusion that such hierarchies should be borne in mind when planning E-E programs. From the linkages between the hierarchical groups, Bart proposed that public and personal attitudes were relatively independent of one another, occurring in separate groups. Attitudes with the fewest positive ecological responses were observed to be associated with restrictions of personal freedoms.

Other findings bearing on the matter of public versus private environmental attitudes were reported by Tichenor _et_ _al_. (1972). From a series of studies dealing with public opinion in Minnesota concerning environmental issues, a general public confidence or optimism that technology would solve these problems emerged. Opinions on the kind of measures which could be taken to control pollution varied sharply according to the degree of personal or local economic effect which could follow. If such controls were seen by the respondents as being likely to affect short-run community interests in a negative way, then positive attitudes did not tend to be shown.

Ditton and Johnsen (1974) studied the attitude patterns of high school juniors and seniors in Wisconsin toward water quality conditions, and compared their responses with those obtained from heads of households in an earlier survey in 1972. In comparison with the adults, students evaluated local water quality more critically, and showed a greater willingness to state that they would allocate public funds to the improvement of water quality. However, although local schools had recently provided intensive E-E programs, the researchers found that the students were unable to show a greater level of relevant environmental knowledge than the general public surveyed earlier.

Summary

Those studies which reported on the level of environmental knowledge among their respondents stated that this level was generally low. In most, but not all cases, males scored higher than females on knowledge inventories, but little difference was found between sexes on most attitude measures, especially where total attitude scores were obtained. Some researchers noted a positive relation between environmental information and attitude scores, encouraging a hypothesis that favorable attitudes could be developed by the provision of suitable information. However, a number of students were reported in which public and private attitudes toward certain issues were shown to be at variance. As the amount of environmental knowledge held by the individuals concerned could be considered to be constant in these situations, the likelihood that attitude development is not, after all, a simple matter cannot be disregarded.

Literature Relating to the Educational Significance of the Findings of a Baseline Study

Particular importance will be given to literature relating to attitude change and to the attitude-behavior relationships in this section.

Once the findings of a baseline study have been clarified, immediate questions arise concerning the uses to which such findings may be put. If (say) deficiencies in certain areas of environmental knowledge are revealed, then the traditional remedies of teachers and schools are available. But matters relating to the changing of any attitudes which the study might reveal, or to any assumption of a necessary attitude-behavior relationship are less clear. However, these latter concerns are of such relevance to environmental education that some reference to the contemporary findings and views of workers in the general fields of social psychology seems warranted. At the beginning of each of the two following sections, a hypothetical question is posed, to act as a focus for the subsequent literature review.

Attitude Change

"If this present study reveals certain attitude patterns among Grade 10 students in Australia, are these attitudes amenable to change by coursework in environmental education?"

McGuire (1969), in his chapter in The Handbook of Social Psychology, lists and describes the four current theories concerning attitude change (p. 266-272). These are the Learning Theory, the Perceptual Theory, the Consistency Theory (containing three important subdivisions--Dissonance Theory, Balance Theory and the Congruity Model)-- and the Functional Theory. While remarking that each has a priori plausibility, McGuire views each as complementary and concluded that "none of the approaches has fared notably well when exposed to concerted research programs" (p. 271). In a recent book, Beliefs, Attitudes, Intentions and Behavior: An Introduction to Theory and Research, Fishbein and

Ajzen (1975) point to the large number of "inconclusive and inconsistent" findings with respect to attitude change (p. 401). In their view, such confusing findings arise from the tendency for researchers simply to manipulate an independent variable and to thereupon measure some dependent variable. According to Fishbein and Ajzen, attitudes (and therefore attitude changes) are just one component of a web of components involving beliefs, attitudes, intentions and behaviors. Each of these components may themselves be seen as having a number of elements, and numerous interactions are possible. In such circumstances it is not surprising that the relatively simple manipulation of independent variables should have such uncertain effect.

The environmental education literature abounds with studies dealing with attempts to produce attitude change. They commonly refer to the effect of a particular E-E course (often brief) on the verbalized beliefs and attitudes of respondents as previously recorded on an attitude inventory prepared by the researcher for this particular occasion. Studies in which participation in a course of E-E did cause some positive shift in attitude as recorded on the instrument being used have been reported by Lyons (1971), Lunneborg and Lunneborg (1971), Buethe (1972), Boon (1972), and DeLucia and Parker (1974). Studies in which no significant attitude change was recorded included those of Berger (1972) and Hulleman

(1972), while Leith and Butts (1974) observed an attitude change in the negative direction after a short course of study.

Summary

Basic research on the matter of attitude change has not taken place with environmental attitudes as the primary focus. Such research has been in the field of general social psychology and has not yet produced a reliable model for either describing the mechanism of attitude change or for prescribing courses of action by which attitudes can be changed with consistent results.

Attitude-Behavior Relationships

"If this baseline study reveals the existence of attitudes reportively defined as being "good," will correspondingly good behaviors toward the environment necessarily follow?"

In McGuire's (1969) analysis of the state of basic research on the matter of attitude change, only a passing reference is made to the relationship between verbalized belief and overt behavior, "because it has been so little studied by basic researchers" (p. 270). However, McGuire notes the need for such research not only for its intrinsic worth but for its special application to advertising and marketing activities, political behavior and social action. The lack of such research, at least until the last few years, might be due in part to the assumed and "common sense" connection between the two variables of belief and behavior. (McGuire seems to be using the terms "attitude" and "belief" synonomously in this section.) Some definitions of attitude contain a statement of such expected attitude-behavior consistency. For example, Kahn and Weiss (1973) regard attitude(s) as "enduring dispositions indicating response consistency," while Fishbein and Ajzen (1975) in proposing their own conceptual model for a relationship between beliefs, attitudes, intentions and behavior recognize that "most investigators would probably agree that attitude can be described as a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object" (p. 6). While such a definition seems to be that which environmental educators have in mind when they stress education for the environment--"New attitudes which will change reproductive behaviors can occur through formal schooling of children in a program of population education" (Slesnick, 1971)--it is, in its attitude-behavior consistency assumption very far from the definition offered by Fishbein (and others) in conceptualizing attitude as "the amount of affect for or against some object" (1975, p. 11).

The classic study of LaPiere (1934) pointed to the danger of assuming attitude-behavior consistency. He showed that the overt behavior of a large number of American hoteliers toward the

Chinese members of a traveling party was very different from that stated by the same hoteliers in response to an attitude questionnaire subsequently sent to them. The hoteliers stated that they would not accept such guests, yet they actually did accept them. Since that time, numerous studies on this "a-b" consistency have been performed, although not, in McGuire's view, qualifying as basic research. The matter is of considerable and direct relevance to marketing research, and the act of making a sale to a customer represents a clearly identifiable behavior, thus simplifying a research design. Pinson and Roberto (1973) analyzed a number of studies in which a high correlation between attitude and behavior had been reported, but stated that "the consumer studies reviewed are semantically inconsistent, thereby obstructing the possibility of reaching agreement among different observers on the meaning of the empirical evidence they contain." The semantic inconsistencies arose from ambiguities in the concept of attitude.

Wicker (1969) analyzed a large number of attitude-behavior studies in areas outside marketing. Although these studies were not concerned with environmental education, the criteria used by Wicker in the selection of studies for his analysis would seem to be of relevance to environmentalists. They were as follows:

1. the unit of observation must be the individual rather than a group;

2. at least one attitudinal measure and one overt behavioral measure toward the same object must be obtained for each subject;
3. the attitude and the behavior must be measured on separate occasions; and
4. the overt behavior must not be merely the subject's retrospective verbal report of his own behavior.

In studies meeting these criteria, the attitudinal data rarely accounted for more than 10% of the variance in observed overt behavior. Wicker remarked that "taken as a whole, these studies suggest that it is consistently more likely that attitudes will be unrelated, or only slightly related to overt behaviors than that attitudes will be closely related to behaviors." According to Wicker (p. 74), the "only writer" at that time who had attempted to combine into a conceptual model several factors beside attitude which might influence behavior was Fishbein. Fishbein's model as reported by Wicker proposed that three variables acted as the basic determinants of behavior:

1. attitudes toward the behavior, e.g. beliefs about the consequences of the behavior, and evaluation of those consequences.
2. normative beliefs, (a) what the individual personally feels he should do, and (b) what he believes society says he should do.
3. motivation to comply with the norms.

Fishbein and Ajzen (1975) have now developed the model further, now including a variable "intention" between attitude and behavior. Intentions are seen as the immediate antecedents of overt behavior. In this model, the intention to perform a particular behavior is given by (p. 301):

$$I = (A_B)w_1 + (SN)w_2$$

where A_B is the attitude toward performing the behavior B, SN is the subjective norm (i.e. the influence of the social environment) while w_1 and w_2 are empirically determined weights. The variable intention itself is seen to have four elements--the behavior, its target, the existing situation and time. A detailed description and analysis of Fishbein's model is beyond the scope of this review, but the purpose of the discussion presented here is to illustrate that current views concerning the attitude-behavior relationship are that the relationship is complex. However, Fishbein and Ajzen's findings lead them to suggest that "attitude toward an object will usually have at best a low relation to any given behavior with respect to that object."

Two studies by Bruvold (1972, 1973) in the field of environmental education are among the very few located in that area which relate to the attitude-behavior relationship. In addition, they bear directly upon the Fishbein suggestion of the likelihood of low relationships existing between attitude toward an object and any (one) given behavior related to that object. Bruvold first reviewed Fishbein's current writings, and the triadic congruence model of Insko and Schopler which proposed balance between the affective, cognitive and connative (behavioral) aspects of personality. After proposing a definition of belief which allowed the use of a pair of diadic congruences (belief-attitude; attitude-behavior) Bruvold described and reported results from two studies dealing with environmental matters. They concerned relationships between the attitudes of certain California residents to the use of reclaimed water, the behavior of these residents with respect to the use of such water for recreation purposes, and their beliefs concerning the need for new water resources because of local shortages, together with the efficacy of scientific versus natural methods of purification. Using multi-stage cluster sampling techniques followed by random selection of dwelling units and adults living in those units, Bruvold arranged for personal interviews to be held with the respondents, placing the interviews in the context of a broad survey of California's water resources. Attitudes were measured by use of a Thurstone-type attitude scale, while behavior and belief measures were taken by the use of structured questions asked during the interview. One-way analysis of variance was computed for each of the comparisons. His results showed that only weak relationships existed between any one belief and attitude, and between attitude and any one behavior.

However, increased consistency was observed with respect to attitude when numbers of beliefs, or numbers of behaviors were considered in combination. Furthermore, he was able to show that behavior itself could bring about change in attitude independent of belief.

Mock (1974) reported a study in which students carried out a survey of 350 adult householders in Lafayette, Indiana. The purpose of the study was to determine prevailing attitudes toward pollution by the residents in that community. The respondents showed commendable concern toward the recycling of solid wastes, and 75% said that they would voluntarily separate this waste into its various components. However, only 15% had ever done so.

A survey carried out by Gallup International on behalf of Keep America Beautiful Inc. and reported by Seed (1970) revealed that young adults had strong public attitudes about littering. However their private actions tended to be in conflict with such a public position.

Finally, the established position of workers in the so-called behavior modification learning field, as expressed by Madsen and Madsen (1972) is of relevance:

> It is much easier for a child to act his way into a new way of thinking than to think his way into a new way of acting. That's why we work with present observable behavior rather than with causes or attitudes. Causes and attitudes are not the problem. Causes will be irrelevant when the behavior changes. Attitudes will change when behavior changes.

In summary, unless the development of environmentally favorable attitudes is to be seen by educators as an end in itself, then the matter of attitude-behavior consistency is of significance in E-E. Little basic research has been carried out on the relationship (especially in the field of E-E, although numerous attitude studies have been made), but seemingly useful conceptual models are appearing. However, a number of analyses of individual studies related to this issue have so far indicated that little consistency can be expected between expressed attitude and subsequent specific behaviors related to that attitude.

III. THE DESIGN OF THE STUDY

The purpose of the study was to assess some aspects of the environmental knowledge and beliefs possessed by Grade 10 students in Australia. Such information has value to educators, especially those preparing cirruculum materials. A subsidiary purpose was to compare the knowledge and beliefs of Grade 10 students in Australia and the USA in these environmental areas.

The basic tool for the study was a 40 item inventory. This instrument was based on a similar inventory prepared at The Ohio State University (Perkes, 1973) and subsequently used for several studies in the United States. Certain modifications were made to the instrument so that it would better conform to the Australian situation.

A sample of 174 schools in the six Australian states was drawn. These states are New South Wales (NSW), Queensland (Qld), South Australia (SA), Tasmania (Tas), Victoria (Vic) and Western Australia (WA). In each of the schools, about 30 students completed the inventory.

Once obtained from the schools, the data were transferred to punch cards for subsequent computer analysis. A combination of standard programs was used so as to provide frequency counts, tabulations and chi-squares, correlations, analysis of variance and factor analysis.

The Instrument

The starting point for the preparation of the instrument was the set of inventories designed and developed in the Faculty of Science and Mathematics Education at The Ohio State University, and used in the study by Perkes (1973). The Ohio State inventories contained 80 different multiple choice items in both cognitive and affective areas. The major fields of environmental concern covered by the items were those of population, pollution and resource matters.

It was decided that essentially the same concepts and beliefs could be surveyed by the use of one consolidated form of instrument, consisting of 30 items in the knowledge area, and 10 concerning attitude or beliefs.

Since one of the objectives of the study was to compare the knowledge and beliefs of Grade 10 students in the USA (as represented by the Ohio State study) with those of corresponding students in Australia, an effort was made to retain as many of the original items as possible. In selecting items suited for an Australian version of the instrument, the major criteria were that selected items should be ones which:

1. were relevant to the Australian environment;
2. had global implications, where possible;
3. were adaptable to Australian use, given that Australian data could be substituted if necessary; and
4. had an acceptable multiple-choice format.

The items were edited and consolidated into one trial form (TF1). The format varied from The Ohio State University version in that the knowledge and attitude/belief items were separated and identified. Since the items in the latter section required the students to indicate the nature of their agreement with positively worded statements, it seemed appropriate to label that section "Beliefs." In the Ohio instrument, the alternatives offered for the beliefs items were agree, neutral, disagree, no opinion, with no explanation given for the difference between neutral and no opinion. For the Australian version stipulative definitions for the meaning of the four alternative responses were provided. The use of the label "attitude" was deliberately avoided.

Trial Form 1

TF1 was administered to four Grade 10 classes from two Metropolitan high schools in South Australia. The teachers were asked to record the time needed by their students for the completion of the 40 items, and whether there were any obvious item or administrative difficulties. It was reported that 25 minutes seemed an appropriate period, and various helpful comments were made. Even though only 150 sets of responses were obtained for TF1, the opportunity was taken to try out some of the data processing arrangements which might be appropriate for the actual survey. Three of the packaged statistical programs available at the State ADP Center were used: TESTAT for item analysis, FACTOR for factor analysis, and BMD IV for differences between schools. Various item and format improvements were made, producing Trial Form 2.

Trial Form 2

TF2 was administered to ten G10 classes in South Australia, containing 336 students in all. Four Metropolitan, two Metropolitan Technical and four Country high schools were selected randomly, the 4:2:4 ratio reflecting the relative numbers of these schools existing in South Australia. In anticipation of the likely student sampling procedure to be followed in the actual study, each school was asked to choose and use one existing heterogenously distributed class group of about 30 students. The same computer programs were used as with TF1, with the addition that the intraclass correlations, ρ , were calculated for both knowledge and belief sections. This information was subsequently used in calculating the size of the sample needed for the Australian study.

Final Form

As a prelude to making plans for the distribution of a final form of the instrument, TF1 had been submitted to the Directors-General of the six Australian State Education Departments, and to the State Directors of Catholic Education together with an outline of the plans for the study. Most showed the instrument to the directors of their Research divisions, and one of these researchers (Webster, from the New South Wales Education Department) remarked that the reading level seemed a "bit high" for G10 students. As TF3 was ready by this time, its readability was discussed with the Reading Consultant for the South Australian Education Department, Dr. Harry Geil. Geil adapted and applied the SMOG Readability formula (McLaughlin, 1969), assessing TF3 to be at about the G13 level. (Meant originally for continuous prose, the SMOG formula was adapted to the set of multiple choice items by using every item and treating the item stem and its longest alternative response as a complete sentence.)

In order to reduce the reading level to that of G10, some reediting of TF3 was undertaken. Sentences were shortened, the number of words containing three or more syllables was reduced, and technical terms were replaced by "every-day" ones where possible. For example, the original wording of Item 4:

DDT is a pesticide which

A. is non-persistent, remains toxic from several days to about 15 weeks

B. is moderately persistent; remains toxic from 1 year to 2 years

C. is persistent; remains toxic for many years

D. is permanently toxic

was altered to read:

Once DDT has been spread to kill pests, it

A. remains active for a few weeks only

B. remains active for one or two years

C. remains active for many years

D. remains active forever.

During this final editing, an item was introduced which gave students a (forced choice) opportunity to identify the major source of their environmental knowledge. In this way it was hoped to gather informal and indirect information about the status of environmental education in Australia. One of the items in the Beliefs section was replaced because the Panel of Environmentalists and Educators (Appendix III) formed for the purpose of establishing a reference point for this section did not reach a consensus on that one item. Following all these adjustments, the readability of the instrument was reassessed and found to be at the Grade 10 level.

Finally, the reliability of the modified instrument was examined using three G10 classes not involved in any of the trials. An acceptable stability coefficient of 0.7 was obtained using test-retest procedures involving a 10 day delay.

The physical design and appearance of a survey instrument is not commonly referred to in the literature, yet the every-day examples of commerce would suggest that such factors are at least likely to affect the response which the document receives. To ensure the best possible reception for this instrument in the schools, efforts were made during the preparation of the final version to choose a typeface, layout and page size which would produce a readable, attractive and economical document. All the items and the detachable response section were made to fit in one sheet so as to minimize distribution and collection tasks within the school and to reduce costs. The Final Form is shown in Appendix I.

The item distribution in the Final Form was as follows:

1. Knowledge Section (30 items)

Area	No. of items		
population	5	nuclear radiation	2
resources	7	chemical persistence	1
pollution; water	4	community health	2
air	5		
solid waste	3	source of knowledge	1

2. Beliefs Section (10 items)

individual rights	2	population control	2
controls	3	nuclear energy	1
"science as savior"	1	local problems	1

The Population

The target population was defined as all students in the tenth grade of the consecutive grading system in the secondary schools of the six states of Australia.

Excluded Population

The population excluded from the study was those G10 students in the two territories of the Commonwealth of Australia, viz. the Northern Territory and the Australian Capital Territory. Geographical and sampling problems contributed to this exclusion. However, the G10 populations of the territories are small, in 1972 contributing 720 and 2358 to an Australian total of 194, 927 (Commonwealth Bureau of Census and Statistics, Australia, 1973, p. 15), while their courses of study and personnel still reflect their recent links with South Australia and New South Wales, respectively.

The Choice of G10 as the Target Population

Grade 10 can be regarded as the final year of general secondary education in Australia. While more and more students are now remaining through G11 and G12, the orientation in these two grades is still heavily directed toward preparing students for specialized tertiary education. The loss of students at the various grade levels is also very high after Grade 10. An extract from the

1972 school census data reveals this striking characteristic of Australian secondary schools.

Table 3.1. Number of Students in Grades, by States, 1972.

	G8	G10	G12
NSW	83,533	62,642	26,546
Qld	36,999	31,137	10,770
SA	24,545	20,806	7,468
Tas	8,148	6,276	1,787
Vic	66,938	53,411	20,367
WA	20,642	17,977	5,648

The target data for the study was set in the October-November 1974 period, near the end of the Australian school year, so that the general education experience should be as complete as possible.

For comparison with the USA studies, it would have been useful to have had a target G12 population. However the loss of about two-thirds of the G10 population between G10 and G12 would affect the comparability of the Australian G12 population to an unacceptable extent. In a practical sense, too, it was felt that schools would be unlikely to cooperate in making their G12 students available for survey purposes during this period, for the students are preparing to sit for a critical set of Public Examinations at this time.

Source of Population Data

The information needed for sampling included a complete listing of all secondary schools in Australia, together with the number of students in each of those schools currently enrolled in G10. The most recent list of this kind was the one prepared by the Australian Council for Educational Research (ACER) for the purposes of the IEA[4] Science Project in Australia during 1970 (Rosier and Williams, 1973). Although more recent data would have been preferable, it was considered that since no major restructuring of the education systems in Australia had occurred since that time, inferences based on a sample drawn from such population data would be applicable to the current situation. The study nonetheless carries the limitation that students in secondary schools established since 1970 had a zero probability of being included in the sample. It is to be noted that a corresponding lack of recent school census information imposed a similar limitation on the Ohio studies (Perkes, 1973).

The Sample

The aim was to draw a sample which would truly represent the target population described. Had it been applicable, the ideal system would have been the simple random selection (srs) procedure, where every student in the designated population had a probability (not equal to zero) of being included. However, such a lottery-like procedure is impractical among a population organized into schools and classes. An alternative procedure was used, which produced an equivalent but necessarily larger sample. The general design of the sampling procedure is that used for the IEA Science Study in Australia, 1970 (Rosier, 1973) and is attributed to G.F. Peaker.

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[4] The IEA is the International Association for the Evaluation of Educational Achievement.

The procedure involved the development of a series of two-stage probability samples. Stage 1 was a sample of schools drawn with a probability proportional to their size (pps), where the size of a school is taken to be the number of G10 students in that school. Stage 2 samples were students selected from among the G10 students in the schools drawn for the Stage 1 sample.

It seemed logical to choose a stratified system, for a number of natural strata exist among the Australian schools, not the least of which is the basic organization of educational systems within state boundaries. Within these strata, variations can be expected to be less than among the whole population of schools, making them attractive sampling frames. The strata identified were:

by state (NSW, Qld, SA, Tas, Vic, WA)
by school system (Government, Catholic, Independent)
by region (metropolitan, non-metropolitan)

while the substrata used were:

type of school (high, technical)
sex

The use of the pps system obviated the need to designate a further stratification by size.

The First Stage Sampling Frames

The ACER was good enough to allow access to the sampling frames prepared for the IEA study, and to give advice during the lengthy process of using the frames to draw the first stage sample.

Each frame is a listing of all the secondary schools in a state, grouped in the order Government, Catholic, Independent. Within these groupings, the schools are separated into Metropolitan and Non-metropolitan, then into school type (e.g. high, technical) where applicable, and a final order is achieved through alphabetization. The number of G10 students in each school is then noted. (For the ACER frames, the students were actually those who were age 14 years. This was found to correspond well to the current number of current G10 students in the schools, since the growth of school numbers since 1970 and an improvement in their holding power compensates for the fact that G10 students are aged 15 plus and that there is a student loss between G9 and G10.) Starting from the top of the list, this student number was listed against the schools in a cumulative fashion. For example, if the first four schools had 156, 246, 321 and 172 G10 students respectively, the cumulative list would be as follows:

School A	1-156
School B	157-402
School C	403-723
School D	724-895, etc.

A cumulative listing of this kind is needed, because the method used to select schools for the sample is the "random start, constant interval" process. When a stratified student-numbered frame is used, this selection process automatically produces a distribution of schools (and therefore of students) which is proportional across the strata.

Calculating the Size of the Stage 1 Sample for Each State

Since it was not a practical possibility to draw a simple random sample (srs) of students from the large school systems, the selection of the students necessarily involved the use of groups or clusters, in which some degree of similarity of response to any instrument would have to be anticipated. Accordingly, in order to achieve the same degree of accuracy as that obtainable with a simple random sampling procedure, a larger number of students must be included in the two-stage sample. The steps involved in calculating the size of this sample were as follows.

(1) Calculating the size of an "srs" sample (n_{srs}). For the

IEA study, an acceptable standard error of the mean of student scores was set at 0.06 x student standard deviation, σ. For this study, the somewhat larger factor of 0.08 was applied as a safety measure, since it would have the effect of increasing the size of the primary sampling unit, the number of schools.

Now the standard error of the mean, $\sigma_{\bar{x}}$, is given by (Glass and Stanley, 1970, p. 248):

$$\sigma_{\bar{x}} = \frac{\sigma}{n_{srs}}$$

thus, $$0.08\sigma = \frac{\sigma}{n_{srs}}$$

and $$n_{srs} = \frac{1}{0.08}$$

hence $$n_{srs} \cong 150 \text{ (students in each state).}$$

(2) Allowing for the clustering effect. Kish (1965) has shown that two factors are involved--the size of the clusters used in the sample, and the intraclass correlation (ρ) among students within those clusters. He has proposed a "design effect," d_{eff}, which is a factor by which n_{srs} must be multiplied to obtain the size of an equivalent two-stage sample.

$$d_{eff} = \rho(b-1) + 1 \text{ (where b = cluster size).}$$

In this study, local experience was used to suggest that a likely cluster (i.e. class) size which would be provided by schools would be about 30. For the IEA studies, a value of 0.10 was established for ρ, but in the planning of the sample for this study it was decided to use as an estimate $\rho = 0.12$ as a safety margin, since no harm can be done by increasing the size of the primary sampling unit. (Subsequent AOV analysis of the data from the 10-school trial yielded $\rho = 0.116$ for the knowledge section.) Substituting,

$$\begin{aligned} d_{eff} &= 0.12\,(30-1) + 1 \\ &= 4.5. \end{aligned}$$

Hence the number of students needed was $n_{srs} \times 4.5$, or $150(4.5) \simeq 700$.

The number of schools needed to provide 700 students per state is 700/30, or 23. However, as a safety margin, the number 30 was used, since it was likely that some schools would not agree to participate, while in others the cluster sizes might sometimes exceed 30 students, since schools were expected to use existing groups. As b exceeds 30, so d_{eff} increases above 4.5 so increasing the required sample size.

Drawing the Stage One Sample

The data from South Australia are provided as an example of the procedure followed.

1. The population

Government schools	
Metropolitan High Schools	6812 G10 students
Metropolitan Tech. High Schools	4830

Non-Metropolitan High	3799
Non-Metropolitan Technical High	825
Area schools	1331
Catholic Schools	
Metropolitan	1369
Non-Metropolitan	171
Independent Schools	
Metropolitan	1448
Non-Metropolitan	-
Total	20,585

2. The constant sampling interval (k)

$$k = \frac{\text{no. G10 students}}{\text{no. schools in sample}}$$

$$= \frac{20585}{30} = 686$$

3. A random start

Using a set of random number tables, the first number less than 686 was used, viz. 147. Taking this as the first selection number, the interval 686 was successively added until the interval 1 - 20585 was used and 30 selection numbers were obtained.

4. The 30 schools

Using the ordered SA sampling frame, the 30 schools "possessing" one of the 30 selection numbers were identified. Only one of these proved to be a school previously used in a trial. It was replaced with the nearest equivalent school on the frame.

A similar procedure was followed for each of the six states. Table 3.2 shows the number and distribution of the schools drawn.

Table 3.2. Stage 1 Sample. Number and Distribution of Schools by State.

	Government	Catholic	Other	Total
NSW	23	6	1	30
Qld	22	6	2	30
SA	26	2	2	30
Tas	20	3	1	24
Vic	23	5	2	30
WA	24	4	2	30
Total	138	26	10	174

Because of the substantially smaller G10 population in Tasmania, a somewhat smaller number of schools was drawn for that state.

The Stage Two Sample

Schools drawn in the Stage 1 sample were contacted by mail (Appendix III) and asked to choose 30 G10 students on one of the three following bases. The first two methods involved the use of an existing class.

A. A class of about 30 students for which the school had already arranged a heterogeneous distribution.

B. Failing 1, the most heterogeneously distributed class available at that grade level (e.g. not, say, a class in French but in one of the core subjects)

C. (preferably) A random selection, if the school organization could permit it, using a random-start, fixed interval procedure (Appendix II).

Provision was made on the return envelope for the school to check which of A, B, or C had been used.

Administrative and Data Collection Procedures

A study of this kind depends heavily for its success on the voluntary cooperation of the schools included in the sample. Unhappily for the would-be researcher, these schools are not fundamentally geared to meet his needs, and are increasingly beseiged by outside people who call on their good offices. An important part of the research design, therefore, was to devise such an approach to the schools that most of them would agree to cooperate.

Since there is a degree of centralism in the organization if not the practices of both the Government and Catholic systems in each state, the first step was to write letters to the appropriate Directors of Education in each state, describing the study and asking for their formal permission to approach the schools in their care. The fact that all the Directors agreed to the request (some quite warmly) could be attributed to their desire to support apparently worthwhile research activities well described. But the researcher gratefully acknowledges the endorsement supplied by the South Australian Director-General of Education, and his counterpart in the parallel Catholic system in that state. Both agreed to send covering letters to their colleagues in each state.

For economic and psychological reasons, it was decided to dispense with the normal activity of writing a preliminary letter of request to the sample schools. Instead, the whole packet of materials was sent at once--an individually addressed letter to the Principal explaining the study and asking for cooperation, short statements describing the administrative procedures involved, the 35 copies of the instrument, and a stamped return envelope for the (deliberately small) student answer slips (Appendix II). One of the most carefully conceived pieces of material in the whole study was the letter directed to the Principals of these schools. During the month allotted for the return of the papers, a few schools were "sampled" by telephone in order to gauge the response. Schools not responding by the due date were contacted by a reminder notice.

Once received, the responses were computer coded and stored to await card punching. Letters of appreciation were sent to cooperating schools and their requests for the information offered in the original letter to the schools were met.

Knowledge and Belief Variables

Item responses, frequency counts, distributions and percentages were taken and compared by strata, using standard computer packages. From the SPSS library of programs, subprogram MARGINALS was used for frequencies, CROSSTABS for crosstabular displays and for chi-square calculations, and CODEBOOK for histograms. Correlations between item responses and between total scores and item responses were calculated by the subprogram PEARSON CORR. The program MANOVA (developed by the Clyde Computing Service) was used for the analysis of variance between groups within strata.

A "preservation of homo-sapiens" score was established, as described below, and its distribution was examined by strata.

The "Homo-sapiens" Analysis

A factor analysis carried out on the data provided by the 10-school Trial 2 suggested that a clear factor was operating over a number of the nine relevant items in the beliefs section of the instrument. In order to determine if some particular belief pattern was being exhibited, it was devided to form a Panel of Educators and Environmentalists and to ask them to respond to the beliefs questions. But rather than setting out to gather yet another set of indivual viewpoints in the hope of finding some commonality, an attempt was made to delineate one specific situation. Lucas (1973) has proposed that environmental attitudes can be polarized according to two referent positions for the environment. One concerns the need for the preservation of homo sapiens as a species. The other represents the immediate well being of the individual. The panel members were asked to study the "beliefs" section of the inventory, and then to take a "preservation of the species" position in responding to the items. A remarkably similar set of responses was received. Appendix III lists the panel members, terms of reference and the distribution of responses.

From this information, a homo sapiens position was established as a reference point from which the positions taken by individual students could be compared. Items 1-9 in the Beliefs section were used to establish a 0-18 scale. The categories Agree, Neutral, Disagree, No Opinion, lent themselves to the establishment of such a scale, since they were tightly defined in the introduction to that section. For each item, a student response which corresponded with the panel viewpoint scored 2. "Neutral" scored 1, disagreement 0 and "no opinion" 0. For each student, a score could then be established on the 0-18 scale, supposedly representing a composite positional viewpoint.

IV. ANALYSIS OF DATA

In this chapter, an analysis of the data obtained during the study is described in both verbal and tabular form. The organization of the analysis report is as follows:

1. The sampling return: extent and distribution
2. The Knowledge section (A)
    (1) frequency counts of the item responses by the total sample
    (2) the development of a new informal stratum from the responses to Item A30
    (3) group comparisons of "best" responses to each item within strata
3. The Beliefs Section (B)
    (1) frequency counts: total sample
    (2) group comparisons of "Agree with Panel" responses
    (3) a composite attitude toward "the preservation of homo sapiens"
    (4) Responses to Item B10 by strata
4. Comparisons between item responses by Grade 10 students in both Australia and the USA
    (1) Knowledge section
    (2) Beliefs section
5. Analysis of variance studies
    (1) between strata groups using raw total Knowledge scores

(2) between strata groups using Belief scores

6. Correlations between item responses, and between item responses and total scores.
7. Factor analysis
8. Alternative second stage sampling procedures: analysis for differences in response

These results are summarized and interpreted in Chapter V.

Sampling Returns and Distributions

A dissection of school responses is shown in Table 4.1. An overall response of 92% was obtained; 160 of the 174 schools approached sent in returns by the due date. The second stage sampling carried out by the schools produced a sample of 4821 students, with a mean class size of 30.9 and a mode of 35. Of these students, 2334 or 49.7% were males and 2361 or 50.3% were females (126 students did not state their sex).

The sampled schools were offered three alternative methods of drawing the stage 2 sample. Table 4.2 shows that all three methods found substantial use, the most frequent (45.2%) being that of choosing one class among a set of classes containing heterogeneous grouping of students.

Table 4.1. Sampling Returns by States: Schools Invited (SI), Schools Responded (SR), and Students (St).

	Government						Catholic					
	Metropolitan			Non-metropolitan			Metropolitan			Non-metropolitan		
	SI	SR	St	SI	SR	St	SI	SR	St	SI	SR	St
NSW	13	10	331	10	10	317	3	3	103	3	3	92
Qld	8	7	205	14	12	351	3	3	104	3	3	93
SA	17	17	514	9	9	255	2	2	68	-	-	-
Tas	7	7	213	13	13	373	2	2	61	1	1	30
Vic	14	13	383	9	7	195	3	3	101	2	1	25
WA	20	17	507	4	3	80	4	4	127	-	-	-
Totals	79	71	2153	59	54	1571	17	17	564	9	8	240

	Independent			Totals			
	SI	SR	St	SI	SR	St	%
NSW	1	1	29	30	27	872	90
Qld	2	2	66	30	27	819	90
SA	2	2	63	30	30	900	100
Tas	1	1	25	24	24	702	100
Vic	2	2	50	30	26	754	87
WA	2	2	60	30	26	774	87
Totals	10	10	293	174	160	4821	92

Table 4.2. Second Stage Sample: Frequency of Three Alternative Methods, as % of Total Sample.

Method	N	Relative Frequency
A (existing heterogeneous group)	2153	45.2
B (most heterogeneous group available)	1471	30.9
C (random selection)	1140	23.9
Missing observations	57	

Knowledge Section

Frequency Counts of Item Responses: Total Sample

Table 4.3 lists the frequency (as %) of response to each of the items in the Knowledge section, A1-29. The "best" responses are keyed with a superscript a, while for seven of the items the symbol b represents a response which, while not "best" has merit in that situation. Figure 4.1 presents these best response frequencies in histogram form, with the items being grouped into areas of similar content (e.g. "pollution"). The dashed lines on the ends of seven of the histograms represent the responses to the "merit" alternatives (b) for those items. The intersecting x symbols on a number of the

Table 4.3. Item Analysis. Section A, "Knowledge." Frequency of responses (as %) to each item alternative.

Item	N	Alternative			
		A	B	C	D
A1	4800	51.7[a]	38.6[b]	8.9	0.9
2	4808	86.7[a]	3.0	8.2	2.1
3	4796	11.0	16.9	37.1	35.1[a]
4	4787	36.5	27.8	23.9[a]	11.8
5	4801	17.6	44.3[a]	25.2	12.9
6	4808	2.9	86.8[a]	3.7	6.6
7	4811	23.4[a]	16.2	46.4[b]	14.1
8	4792	33.9[a]	17.0	21.6	27.5
9	4791	39.9	26.0[a]	4.5	29.6
10	4794	7.9	12.0	63.1[a]	17.1
11	4785	44.6	16.6	19.2	19.6[a]
12	4794	30.2[b]	52.6[a]	6.0	11.2
13	4801	67.2	25.2[a]	3.3	4.3
14	4798	11.9[b]	71.6	13.5[a]	3.0
15	4634	21.7	35.2[a]	21.6	21.4
16	4810	18.2	16.1	57.0[a]	8.7
17	4774	60.5	25.3	8.6[a]	5.6
18	4772	4.4	14.4	38.5[a]	42.7
19	4735	7.9	28.6	45.9[b]	17.7[a]
20	4738	13.8	25.3[a]	34.4	26.5
21	4791	10.5	9.3	58.9[b]	21.3[a]
22	4784	10.3	31.4[a]	32.2	26.1
23	4805	25.8	14.3[b]	56.0[a]	4.0[b]
24	4788	2.6	5.1	48.3	44.0[a]
25	4771	15.5	50.6[a]	20.6	13.3
26	4771	48.8[a]	30.0	12.1	9.1
27	4776	18.3	44.1[a]	23.9	13.8
28	4791	50.1[a]	44.3	4.0	1.6
29	4791	66.2[a]	5.9	11.6	16.2
30	4744	35.9	4.2	44.8	15.1

[a] "Best" response

[b] Has merit but is not "best" response

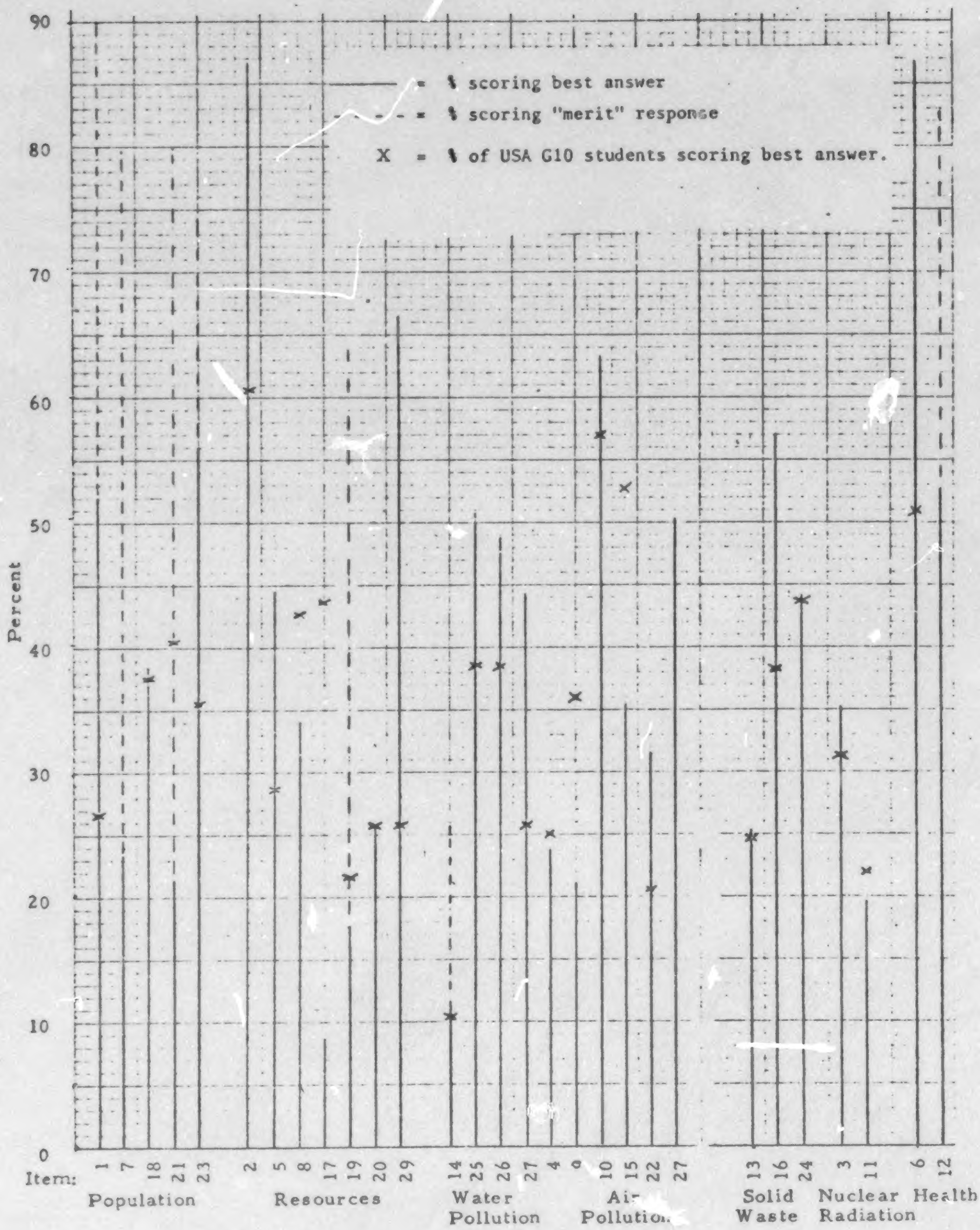

Figure 4.1. Frequency of Response (as % "best answer"). Total Sample by Knowledge Item Groups.

histograms show, for comparison purposes, the % best responses to corresponding items by all sampled Grade 10 students in the USA (data from their 1973 collection supplied by The Ohio State University, and used with permission). These comparative results are analyzed in Section 4 of this chapter.

The following analysis of the results obtained from all sampled Australian G10 students is based on the related content area groupings shown in Figure 4.1.

Population (Items A1, 7, 18, 21, 23). If both "best" and "merit" responses are considered, then Figure 4.1 shows that Australian students have a good grasp of population trends, with the exception of item 18, referring to actual levels of world population. Here, 38.5% gave the "best" response, but another 42.7% selected alternative D, indicating that they were prepared to overestimate the population rather than the reverse. In item 21, only 21.3% knew the extent of urbanization in Australia, although an overall 80% knew that the distribution was at least 70% urban.

Resources (Items A2, 5, 8, 17, 19, 20, 29). Item 2. The alternative "solar energy" was chosen from three others as the energy hope for the future by 86.7% of the students. The likely duration of some basic resources (#5) such as tin, oil and copper was correctly identified by 45.2%, with the extremes of 10 and 200 years attracting some 30%.

Item 8: While 33.9% correctly estimated that, in an overall sense, Australia's underground water resources are being used at an unknown rate, all but 17% were prepared to accept that the usage rate was likely to be at least as high as the replacement rate.

Item 17: The average daily use of water by Australian people was grossly underestimated, with 8.6% identifying the best response of 100 gallons per day; 60.5% selecting the lowest rate of 10 gallons per day.

Item 19: An overall 63.6% selected alternatives nominating that the daily use of non-renewable resources by the USA is 25% or more of the world total. The best response of 50% was identified by 17.7%.

Item 20: Most students overestimated Australia's natural gas reserves; 23.3% selecting the actual figure of 25 years, while another 60.9% chose either 50 or 100 years.

Item 29: The difference between renewable and non-renewable resources was apparently understood by 66.2%, but a sizable 28.8% chose fossil fuels and minerals as being renewable.

Pollution (Items 14, 25, 26, 27, 4, 9, 10, 15, 22, 28).

Item 14: The effect of fertilizer application as the major source of phosphate water pollution was known by 13.5% of students. Most (71.6%) blamed "industry."

Item 25: While 50.6% knew that the decomposition of organic materials in water removes oxygen from the water, the seemingly unlikely alternatives of hydrogen and sulphur also proved attractive to 33.9%.

Item 4: The long and active life of DDT was appreciated by only 23.9%.

Item 9: Some 26.0% correctly believed that solid particles suspended in the air would tend to reduce the earth's temperature, 29.6% thought that such particles had no effect while 39.9% believed that they had the reverse effect of increasing the temperature of the earth.

Item 15: The major effect of an atmospheric inversion was known to 35.2% of the students. A large number (21.4%) believed that such an inversion actually produces pollutant particles

Item 22: More students selected carbon monoxide as the most corrosive of the listed atmospheric pollutants than the reactive sulphur dioxide (32.2% c.f. 31.4%).

Item 28: Fueled transportation devices were selected by most students (50.1%) as the greatest source of air pollution, although almost as many (44.1%) selected "industry."

Solid Wastes (Items 13, 16, 24). Item 13: Factories were regarded as the chief source of solid waste by 67.2% of the respondents; 25.2% correctly identified residential operations.

Item 16: Dumping and covering with soils was recognized as the cheapest current method of solid waste disposal by 57.0%. A sizable proportion (16.1%) were attracted to the "recycling" alternative.

Item 24: The fact that there has been a big increase in the weight of solid garbage produced per head of population in Australia was recognized by an overall 92.3% of the students; 44.0% selecting the "best" alternative of 10 lb per head per week.

Nuclear Radiation (Items 3, 11). Item 3: More students chose medical sources than natural sources (37.1% c.f. 35.1%) as the major overall source of nuclear radiation. However, in item 11 relating to man-made radiation in Australia, no less than 44.6% selected atomic bomb fallout in preference to the "best response, medical sources, 19.6%.

Related health matters (Items 6, 12). The students had little doubt about the major cause of death in the 18-24 year age group, 86.8% correctly identifying the motor vehicle. They knew too that it was the legal responsibility of either the State or the Federal government to ban the sale of polluted food.

Responses to Item A3C, Source of Environmental Knowledge

The responses to this item, for the total sample are listed on the end of Table 4.3. The item was designed to provide information about the sources of environmental knowledge, as perceived by the students themselves. Alternatives A and B (general education at school and special courses at school) accounting for the "in school" sources, were selected by 40.1% of the respondents. Alternatives C and D, accounting for "out of school" sources (the media, and discussion with others) attracted 59.9%.

The very small number of students who nominated B (special courses) is to be noted.

The distribution of these responses across the listed strata of state, school type, region and sex is also shown in Table 4.4. Chi-square statistics have been calculated for each alternative, after dichotomizing the responses into "A; not-A"; "B; not-B"; etc. The symbol * shows where these chi-square values are statistically significant at the 0.001 level.

The distributions and calculations show that Western Australian students placed far more reliance on general school courses, than did students from Queensland (47.9% vs. 23.9%). These two states again occupied the high and low positions in alternatives C and D, but were naturally reversed with respect to A.

Two of the four alternatives produced significantly different responses between School Types. In A, Government school students indicated a greater dependence upon General school courses than did the others (37.7% to 29.7%/29.4%). In B, among a small overall response, students from Catholic schools indicated a higher exposure to Special Courses than did the others. This observation is stated with some reservation, however, not only because of the accumulation of these responses at one end of the distribution tail, so lowering practical significance, but because of

Table 4.4. Frequency of Response (as %) to Item A30, "Source of Environmental Knowledge," by (1) State, (2) School Type, (3) Region and (4) Sex.

	A	B	C	D
State				
NSW	33.0	3.1	49.4	14.5
Qld	23.9	3.5	53.0	19.6
SA	40.5	4.6	39.5	15.5
Tas	34.7	3.4	48.0	13.9
Vic	35.6	6.0	43.2	15.3
WA	47.9	5.0	35.6	11.5
χ^2 (5 df)	110.14*	11.77	69.14*	22.16*
School Type				
Govt.	37.7	3.8	43.5	15.1
Catholic	29.7	7.2	49.2	13.9
Independent	29.4	2.1	50.0	18.5
χ^2 (2 df)	23.59*	21.89*	11.99	3.48
Region				
Metropolitan	33.9	3.3	48.3	14.6
Non-metropolitan	37.1	4.9	42.6	15.4
χ^2 (1 df) corrected	4.97	6.64	14.42*	0.57
Sex				
Male	32.1	3.8	49.5	14.5
Female	39.4	4.6	40.5	15.5
χ^2 (1 df) corrected	26.80*	1.81	38.20*	0.68

*$p < 0.001$

an effect to be discussed under "Interpretations and Explanations" in Chapter V.

Metropolitan students registered a significantly higher degree of dependence on the Media than did Non-metropolitan students.

Males and females responded with significant differences in alternatives A and C. In A, females showed greater dependence on general school courses than did males (39.4% vs. 32.1%). In C, males showed greater reliance on reading and the media (49.5% vs. 40.5%).

Group Comparisons of "Best" Responses to Each Item within Strata

Table 4.5 lists the percentage of students selecting the "best" response in each of Items A1-29, arranged in constituent groups within each stratum. A new stratum has been added--"Source of Environmental Knowledge"-- as discussed in the preceding section. For comparisons between groups, chi-square statistics have been calculated and listed. Those values marked * again represent those which are statistically significant with a probability less than 0.001, for the number of degrees of freedom stated. For this calculation, responses to each item were scored as % correct, or as % "other."

Between States. In 17 of the items, significant differences appeared between states. For these items, the number of times in

Table 4.5. Frequency of "Best Answer" Responses to Knowledge Items A1-29 by (1) State, (2) School Type, (3) Region, (4) Sex, and (5) Source of Knowledge.

	A_1	A_2	A_3	A_4	A_5
State					
NSW	46.9	85.4	35.8	26.7	46.6
Qld	50.1	88.0	38.9	22.3	35.7
SA	48.4	88.4	33.7	20.3	46.4
Tas	58.1	80.3	29.9	27.1	47.6
Vic	50.4	85.9	32.8	23.2	43.2
WA	56.5	89.7	37.5	23.1	45.6
χ^2 (5 df)	31.72*	34.94*	18.27	15.51	32.22*
School Type					
Govt.	50.5	86.1	35.4	23.0	44.3
Catholic	54.9	87.2	34.1	25.4	42.4
Independent	54.3	89.4	30.0	28.0	47.4
χ^2	6.05	3.06	3.73	5.19	2.30
Region					
Non-metropolitan	51.5	84.8	37.0	25.4	42.7
Metropolitan	51.4	87.5	33.5	22.6	45.1
χ^2	0.00	6.55	5.71	4.60	2.39
Sex					
Male	53.7	90.0	37.7	28.5	45.1
Female	49.5	83.3	32.1	19.1	43.3
χ^2	8.01	45.02*	16.20*	56.05*	1.45
Source of Knowledge					
General Ed.	52.4	87.2	35.0	19.5	43.2
Special	46.8	82.6	29.9	20.4	41.3
Media	52.3	87.6	35.2	29.4	46.6
Outside D.	48.2	83.1	34.2	18.7	40.6
χ^2	6.11	12.76	2.47	64.73*	9.86

(Continued on next page)

Table 4.5. (Continued)

	A_6	A_7	A_8	A_9	A_{10}
State					
NSW	80.3	20.0	40.3	20.6	58.5
Qld	88.4	19.0	35.3	20.3	60.0
SA	88.7	30.2	27.3	29.9	65.8
Tas	91.6	26.2	29.9	26.8	62.3
Vic	86.3	21.6	35.4	35.1	63.9
WA	84.8	23.1	33.6	23.0	66.1
χ^2 (5 df)	52.85*	42.27*	39.52*	70.91*	17.40
School Type					
Govt.	86.4	24.3	33.6	26.2	63.4
Catholic	86.4	20.0	36.7	26.2	58.7
Independent	89.1	21.5	25.9	19.8	64.8
χ^2	1.73	7.29	11.13	5.96	6.90
Region					
Non-metropolitan	86.9	20.8	32.8	23.7	61.4
Metropolitan	86.3	25.1	34.2	27.2	63.5
χ^2	0.35	11.39*	0.88	6.95	2.08
Sex					
Male	87.5	23.1	35.9	30.9	68.2
Female	85.6	23.3	31.6	20.8	57.2
χ^2	3.44	0.02	9.54	61.87*	60.56*
Source of Knowledge					
General Ed.	87.4	23.9	32.9	26.0	65.0
Special	79.6	21.9	31.3	20.9	61.2
Media	87.3	23.8	34.0	26.6	61.9
Outside D.	84.8	21.6	35.2	24.3	60.6
χ^2	12.29	1.89	1.84	4.06	5.82

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Table 4.5. (Continued)

	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}
State					
NSW	25.4	56.1	26.0	9.3	30.7
Qld	19.9	45.2	25.0	20.0	40.8
SA	10.6	53.4	23.2	13.3	31.7
Tas	21.3	53.0	24.2	14.0	29.8
Vic	17.5	52.8	25.7	12.7	41.6
WA	23.7	53.0	26.5	11.4	28.7
χ^2 (5 df)	75.47*	22.46*	3.33	46.84*	58.17*
School Type					
Govt.	19.5	51.6	24.4	14.0	33.5
Catholic	19.7	52.6	25.4	11.2	31.7
Independent	20.3	60.1	33.8	12.3	44.4
χ^2	0.119	7.88	12.90	4.79	16.33*
Region					
Non-metropolitan	19.2	52.0	23.4	14.5	33.8
Metropolitan	19.9	52.5	26.2	12.8	33.9
χ^2	0.32	0.10	4.79	2.70	0.00
Sex					
Male	18.5	53.2	28.1	19.3	40.1
Female	21.3	51.5	21.9	7.7	27.9
χ^2	5.51	1.38	24.47*	135.91*	78.31*
Source of Knowledge					
General Ed.	19.6	52.6	23.3	11.8	29.7
Special	22.6	45.3	20.4	12.9	33.8
Media	20.1	54.6	27.9	15.1	37.5
Outside D.	18.5	47.6	23.9	13.0	32.7
χ^2	1.96	14.81	14.54	9.03	26.12*

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Table 4.5. (Continued)

	A_{21}	A_{22}	A_{23}	A_{24}	A_{25}
		State			
NSW	20.5	31.7	59.1	46.1	47.9
Qld	21.7	29.7	55.7	42.2	48.5
SA	24.1	28.4	55.2	37.3	49.2
Tas	18.7	39.2	64.7	49.1	51.0
Vic	19.9	29.8	52.0	41.8	49.7
WA	21.6	29.1	48.4	46.9	54.8
χ^2 (5 df)	8.49	27.26*	47.68*	30.39*	9.83
		School Type			
Govt.	20.4	32.3	55.3	42.8	50.7
Catholic	23.9	26.7	55.3	48.9	46.6
Independent	23.9	28.3	62.8	41.3	52.2
χ^2	6.13	10.58	6.24	10.75	4.86
		Region			
Non-metropolitan	17.5	30.8	56.5	45.0	50.9
Metropolitan	23.5	31.3	55.3	42.9	49.6
χ^2	24.40*	0.12	0.61	2.14	0.71
		Sex			
Male	24.5	34.7	57.0	46.5	54.7
Female	17.8	27.9	54.7	41.1	45.7
χ^2	31.01*	25.20*	2.34	13.70*	37.77*
		Source of Knowledge			
General Ed.	19.9	29.0	54.3	41.6	49.7
Special	19.9	23.9	45.8	44.3	45.8
Media	23.1	35.0	58.9	46.6	52.4
Outside D.	18.0	27.8	53.4	40.4	45.3
χ^2	12.65	26.77*	19.67*	13.57	12.85

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Table 4.5. (Continued)

	A_{16}	A_{17}	A_{18}	A_{19}	A_{20}
			State		
NSW	57.0	8.0	36.2	16.7	25.6
Qld	61.1	7.7	34.2	15.4	23.8
SA	49.3	7.6	40.2	21.3	27.3
Tas	54.0	8.7	43.6	18.9	28.3
Vic	55.7	10.5	35.7	15.1	21.2
WA	65.1	8.8	39.3	16.1	27.6
χ^2 (5 df)	50.94*	5.88	19.61	17.04	15.69
			School Type		
Govt.	56.4	7.7	38.2	17.3	25.3
Catholic	55.8	12.7	38.8	18.4	23.5
Independent	66.6	7.5	35.5	14.3	22.2
χ^2	11.89	21.96*	1.02	2.49	2.39
			Region		
Non-metropolitan	55.3	8.2	38.4	16.2	26.5
Metropolitan	57.9	8.7	37.9	18.1	23.8
χ^2	3.03	0.27	0.10	2.75	4.37
			Sex		
Male	62.7	9.0	35.6	16.3	24.7
Female	51.5	7.9	40.7	18.4	24.9
χ^2	58.96*	1.76	12.72*	3.47	0.01
			Source of Knowledge		
General Ed.	54.1	7.5	39.0	16.9	25.7
Special	51.7	10.9	39.3	17.4	24.9
Media	59.9	8.6	37.4	17.5	24.2
Outside D.	56.3	9.8	37.8	17.9	24.6
χ^2	15.24	5.14	1.15	0.40	1.28

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Table 4.5. (Continued)

	A_{26}	A_{27}	A_{28}	A_{29}
		State		
NSW	50.3	45.5	48.5	65.4
Qld	43.5	48.0	45.9	63.4
SA	56.1	45.2	49.2	69.0
Tas	38.2	42.2	49.4	62.7
Vic	44.8	44.6	50.5	65.3
WA	54.7	35.5	55.4	68.2
χ^2	76.06*	30.05*	15.66	11.46
		School Type		
Govt.	48.9	44.2	50.4	65.2
Catholic	48.0	40.0	46.6	64.7
Independent	42.0	46.1	50.2	76.1
χ^2	5.20	5.44	3.76	14.93*
		Region		
Non-metropolitan	46.2	43.5	48.5	63.0
Metropolitan	49.6	43.7	50.5	67.5
χ^2	5.17	0.01	1.78	10.15
		Sex		
Male	46.9	44.2	54.9	67.4
Female	49.9	43.2	44.8	64.5
χ^2	4.05	0.45	48.04*	4.23
		Source of Knowledge		
General Ed.	50.5	41.9	49.1	63.4
Special	45.3	34.8	43.8	62.2
Media	47.6	46.5	51.4	70.5
Outside D.	46.2	43.2	49.7	60.1
χ^2	5.62	15.31	5.32	36.65*

$^*p < 0.001$

which a school was clearly "highest" or "lowest" was as follows:

	NSW	Qld	SA	Tas	Vic	WA
High	4	2	2	5	2	3
Low	4	2	3	2	-	3

The highs and lows were widely distributed among the six listed areas of environmental knowledge. Tasmanian students appeared to know more than the other students about population matters, while South Australian students appeared least well informed about solid wastes and about "man-made" nuclear radiation.

Between School Types. Only three of the 29 items yielded significant differences. Students from Catholic schools tended to be less likely to be wrong about water usage than other students, in item 17, while students from Independent schools were better informed about inversions (item 15) and renewable resources (item 29).

Sex. In 15 of the 29 items, significant differences by sex were observed. Only in item 18, concerning world populations, did females score significantly higher than males. In all 14 other cases, males scored higher than females. In the 10 items dealing with pollution, for example, all but two (items 26 and 27) produced significant differences with males outscoring females in every case.

Source of Environmental Knowledge. In 5 of the 29 items significant differences emerged (items 15, 22, 23, 27 and 29). In each case it was the "media" group which scored highest.

Beliefs Section

Frequency Counts of Item Responses: Total Sample

Frequency counts for the 10 items in this section are presented in Table 4.6. For items B1-9, the responses marked by an asterisk (*) represent an agreement with the Panel viewpoint directed at the "preservation of homo-sapiens." Unlike the "best" answers in the knowledge section, therefore, these "agree with Panel" responses do not necessarily represent a most-desirable response but serve to indicate a sharp reference position. Figure 4.2 presents these Agree with Panel responses in histogram form. The x symbols represent the % of Grade 10 students in the USA whose responses to similar items agreed with the Panel. In Figure 4.2, the items are grouped together in areas of similarity. Taken item by item the responses may be interpreted to indicate the following.

Item 1: That people must appreciate and respect the rights of others is believed by 84.3% of the students.

Item 2: That strong Governmental anti-pollution laws are necessary is agreed by 50.2%, but 21.9% disagree with that view.

Item 3: The proposition that "science" could solve pollution and population problems before they became too serious is disagreed with by 85.1%.

Table 4.6. Item Analysis. Section B, "Beliefs." Frequency of response (as %) to each item alternative.

Item	N	A	B	C	D
B1	4803	84.3[a]	10.1	2.7	2.9
2	4805	50.2[a]	23.1	21.9	4.8
3	4806	3.3	7.7	85.1[a]	3.9
4	4797	21.2	31.0	33.4[a]	14.4
5	4803	58.9[a]	22.8	10.2	8.1
6	4796	58.8[a]	19.2	14.0	8.0
7	4799	39.0	29.7	22.0[a]	9.3
8	4798	8.2	19.9	55.2[a]	16.8
9	4778	51.4	38.0	9.2[a]	1.4
10	4713	32.3	17.6	15.7	34.4

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[a] Represent a reference position taken by a panel: a "preservation of homo-sapiens" viewpoint.

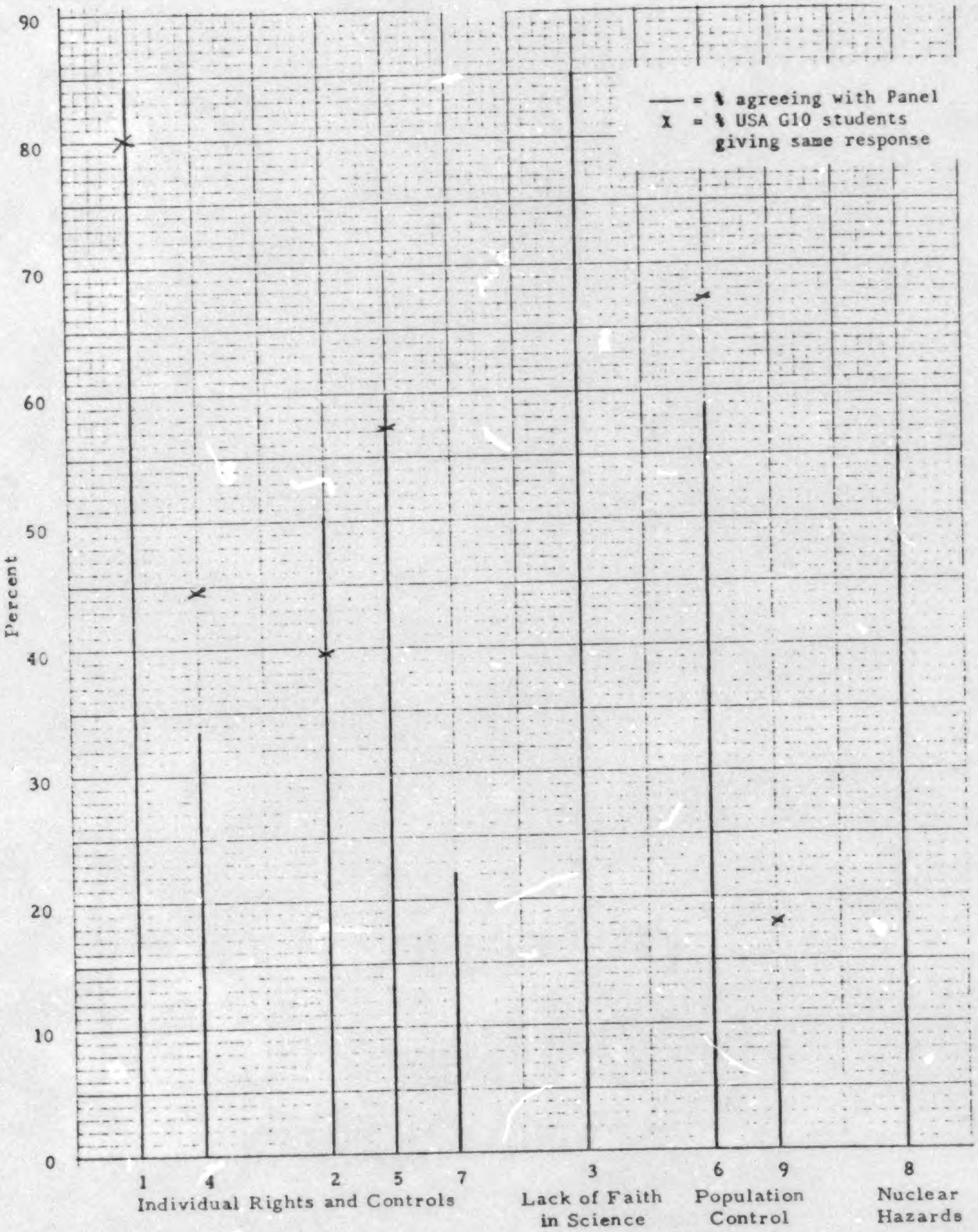

Figure 4.2. Frequency of Response (as % agree with panel). Total Sample by Belief Item Groups.

Item 4: The students tended to appreciate the conflict of interests represented by this item. Responses were more evenly divided, with a relatively large group (14.4%) being unable to express a definite viewpoint on the position of individual freedoms versus the imposition of laws to protect the quality of life.

Item 5: That controls designed to protect the environment should be placed on industry even if "things will cost more" is agreed upon by 58.9%. A low 10.2% disagreed with this view.

Item 6: The importance of family planning as a means of population control is believed in by 58.8%.

Item 7: The unrestricted use of motor vehicles is favored by the largest group of respondents to this item (39.0%).

Item 8: Only 8.2% agree that it will be vital to proceed with the production of electricity from nuclear reactors no matter what the radiation hazards might be. Of all the items, this one had the largest group of students who were not able to express an opinion (16.8%).

Item 9: Only 9.2% of the students agreed with the Panel viewpoint that taxable deductions for children should be decreased; 51.4% wanted them increased.

Comparisons between Groups within Strata

Table 4.7 displays the percent "Agree" responses by strata. The delineated strata are State, School Type, Region, Sex and

Table 4.7. Frequency of Response (as % agree with panel) to Belief Items B1-9 by (1) State, (2) School Type, (3) Region, (4) Sex, and (5) Source of Knowledge.

Item:	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9
					State				
NSW	84.5	52.9	88.3	38.3	58.7	56.5	19.5	56.5	8.3
Qld	86.3	47.7	84.5	32.2	58.2	54.9	21.5	52.2	9.9
SA	83.1	53.1	83.7	32.3	59.6	61.8	23.2	55.3	11.0
Tas	87.6	49.3	87.7	32.9	59.7	65.1	23.9	57.9	7.4
Vic	83.5	49.9	83.0	33.6	60.7	55.2	24.5	53.2	10.2
WA	81.1	47.5	83.1	30.6	56.5	59.9	20.0	56.0	8.2
χ^2 (5 df)	15.27	9.[illegible]	17.60	13.36	3.39	26.27*	9.97	7.04	9.25
					School Type				
Govt.	83.2	49.5	85.2	32.1	59.4	61.3	22.2	54.5	9.8
Catholic	88.8	51.2	84.1	36.4	55.1	42.8	20.6	57.0	6.6
Independent	86.0	55.6	86.3	41.3	62.5	71.0	24.6	59.0	9.2
χ^2 (2 df)	16.43*	4.44	1.03	14.34*	6.74	112.15*	2.03	3.67	8.00
					Region				
Metropolitan	83.6	52.6	84.9	34.6	59.2	58.4	23.3	55.9	9.1
Non-Metropolitan	85.5	46.3	85.4	31.4	58.4	59.5	20.0	54.0	9.4
χ^2 (1 df corrected)	3.02	17.83*	0.21	5.30	0.27	0.53	7.12	1.66	0.079

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Table 4.7. (Continued)

Item:	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9
					Sex				
Male	81.4	57.9	82.1	30.8	62.4	56.1	22.1	58.6	11.1
Female	87.7	43.1	88.2	36.0	55.3	61.5	22.0	52.0	7.3
χ^2 (1 df corrected)	35.78*	101.56	33.62*	13.92*	23.96*	14.00*	0.0084	20.22*	19.58*
				Source of Knowledge					
General Ed.	84.8	47.6	85.0	31.6	58.2	60.1	18.8	53.6	8.1
Special	78.5	46.0	77.5	34.8	47.0	50.8	22.1	41.7	12.6
Media	86.3	54.7	87.0	35.8	62.3	59.8	23.8	58.0	9.0
Outside D.	80.0	45.1	82.4	29.8	53.1	56.1	24.6	53.2	11.4
χ^2 (3 df)	21.51*	30.26*	19.65*	12.02	32.42*	9.60	16.95*	22.22*	9.48

*$p < 0.001$

Source of Information as represented by student responses to Item A30. Chi-square statistics are shown for each item in each stratum.

Between States. Only one of the items, B6, yielded a statistical difference between states. Tasmanian students were rather more prepared to support family planning than students in other states (65.1% vs. a mean of 58.8%).

Between School Types. Significant differences appeared in three items, #1, 4 and 6. In item 6 there was a large difference between school types in the degree of support shown by their students toward family planning as a means of easing population pressures. Students from Catholic schools showed a 41.3% agreement toward limitation, compared with 61.3% and 71.0% among students in Government and Independent schools.

Metropolitan: Non-metropolitan areas. Non-metropolitan students were less in favor of Government anti-pollution controls than metropolitan students. No other item yielded significant differences.

Between Males and Females. Eight of the nine items yielded significant differences by sex. In contrast with the Knowledge section where male students rated higher than females in all but one of 15 cases of significant differences, females agreed with the Panel more strongly than did the males in four of the eight items.

Item 1: Females were even more supportive of the need to appreciate and respect the rights of others (87.7% vs. 81.4%).

Item 2: Males were more strongly in support of Government anti-pollution controls (57.9% vs 43.1%).

Item 3: Females were more inclined than males to worry about current problems in spite of the hope that science might solve them (88.2% vs. 82.1%).

Item 4: Females gave more support to the Panel view that individual freedoms were less important than the enforcement of conservationist laws (36.0% vs. 30.8%).

Item 5: Support for specific industrial controls for industry was higher among males than females (62.4% vs. 55.3%).

Item 6: Females favored family planning more strongly than males did (61% vs. 56.1%).

Item 7: Both had similar views about the desirability of restricting use of motor vehicles. Only 22% believed that such action was appropriate.

Item 8: Males were more concerned than females about the possible dangers from nuclear reactors (58.6%; 52.0%).

Item 9: Neither was highly supportive about a proposal to decrease family tax allowances for children, but males (11.1%) were more favorable to the view than females were (7.3%).

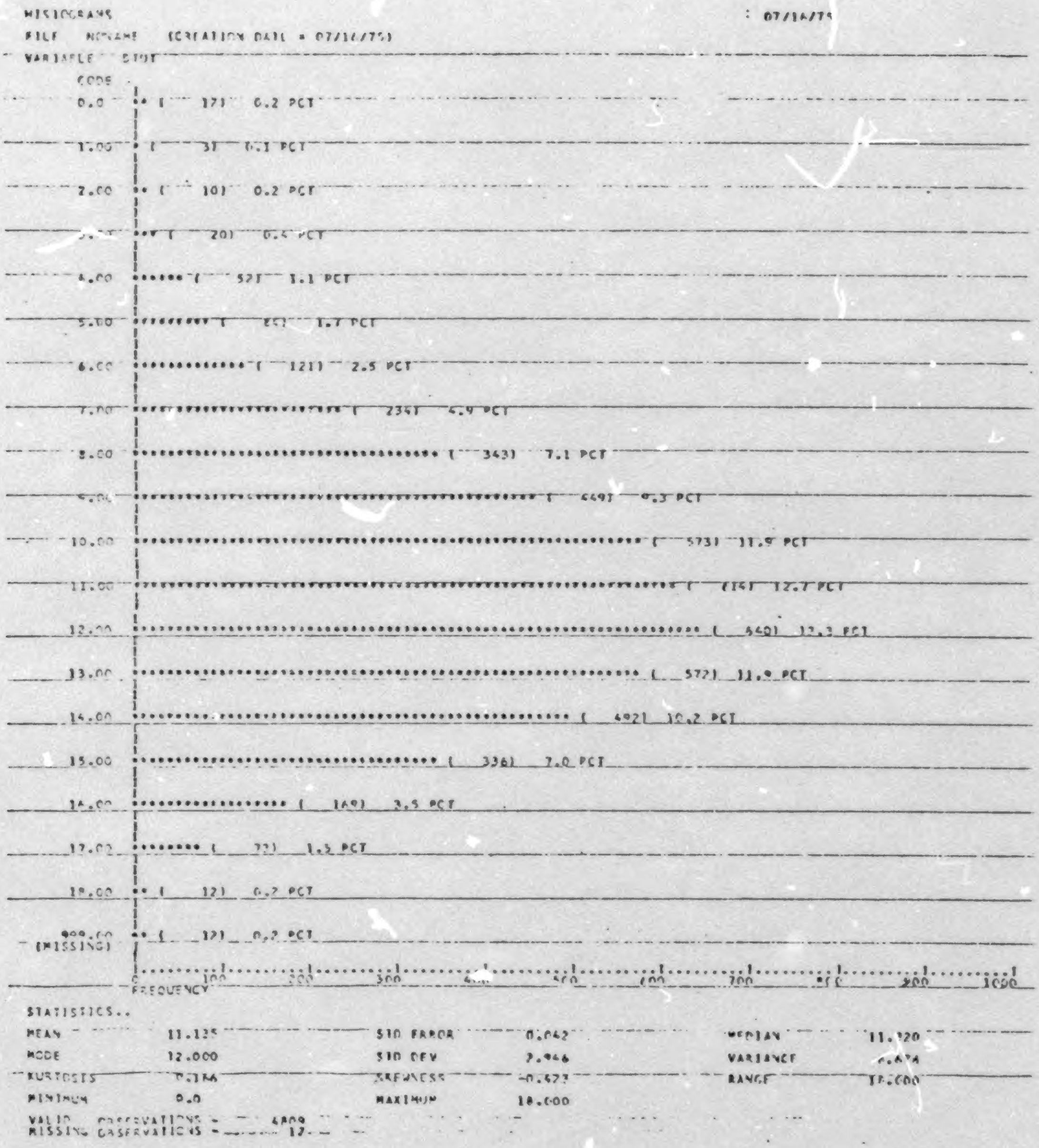
Source of Environmental Knowledge. This student-nominated informal stratum yielded six items in which significant differences were apparent, viz, in Items 1, 2, 3, 5, 7 and 8. In all but item 7, the "Reading and Media" group agreed most strongly with the Panel.

An Attitude toward the Preservation of Homo-Sapiens

Student responses to the first nine items in the Beliefs section were scored and summed by awarding two points for each Agreement with Panel response, and one point for each Neutral view (these terms were defined in the Instrument, Appendix I). These scores are displayed in histogram form in Figure 4.3. With a possible range from 0-18 points, a mean of 11.1 was recorded in a distribution showing a negative skewness (-0.423). As defined in Chapter I, this summation of a set of strength of belief statements is taken to represent an attitude toward the preservation of homo-sapiens. On this basis, Australian Grade 10 students show a favorable attitude of 66.5%.

Responses to Item B10, Serious Local Problems

For the whole sample, the responses to this item appear in Table 4.6. They indicate that of the four alternatives offered, Pollution (A) and Traffic Accidents (D) were seen as posing the greatest problems (32.3% and 34.4% c.f. 17.6% for B and 15.7% for C).



```
HISTOGRAMS                                                              : 07/16/79
FILE    NONAME    (CREATION DATE = 07/16/79)
VARIABLE    BTOT
     CODE
      0.0    I** (     12)   0.2 PCT
             I
      1.00   I* (     3)   0.1 PCT
             I
      2.00   I* (     10)   0.2 PCT
             I
      3.00   I** (     20)   0.4 PCT
             I
      4.00   I****** (     52)   1.1 PCT
             I
      5.00   I********* (     83)   1.7 PCT
             I
      6.00   I************* (    121)   2.5 PCT
             I
      7.00   I************************ (    236)   4.9 PCT
             I
      8.00   I*********************************** (    343)   7.1 PCT
             I
      9.00   I********************************************* (    449)   9.3 PCT
             I
     10.00   I********************************************************** (    573)  11.9 PCT
             I
     11.00   I************************************************************** (    614)  12.7 PCT
             I
     12.00   I**************************************************************** (    640)  13.3 PCT
             I
     13.00   I********************************************************** (    572)  11.9 PCT
             I
     14.00   I************************************************** (    492)  10.2 PCT
             I
     15.00   I********************************** (    336)   7.0 PCT
             I
     16.00   I***************** (    169)   3.5 PCT
             I
     17.00   I******** (     72)   1.5 PCT
             I
     18.00   I** (     12)   0.2 PCT
             I
    999.00   I** (     12)   0.2 PCT
  (MISSING)  I
             I.........I.........I.........I.........I.........I.........I.........I.........I.........I.........I
             0        100       200       300       400       500       600       700       800       900      1000
             FREQUENCY

STATISTICS..
MEAN           11.135          STD ERROR       0.042          MEDIAN         11.320
MODE           12.000          STD DEV         2.946          VARIANCE        8.678
KURTOSIS        0.186          SKEWNESS       -0.523          RANGE          18.000
MINIMUM         0.0            MAXIMUM        18.000

VALID   OBSERVATIONS -       4809
MISSING OBSERVATIONS -         12
```

Figure 4.3. Histogram, Total Belief Scores (2, 1, 0 scoring).

The distribution of these responses by strata are shown in Table 4.8. The chi-square calculations have been made on the basis of dichotomized data, and the symbol * represents significance at the 0.001 level.

Among the states, Queensland students saw pollution as a smaller problem than did those in the other states (24.9% vs. four states recording about 35%). Both Queensland and Victorian students were more concerned about the seriousness of crime than were other students. A large difference emerged in alternative D, "Traffic Accidents," where 44.4% of Western Australian students nominated this as the greatest problem compared with 25.4% in Victoria.

Only one of the four alternatives yielded a significant difference between school types. Catholic school students were more inclined to see "Crime" as the major problem than were students in other schools.

The metropolitan, non-metropolitan stratum produced three significant differences, in alternatives A, B, and D. Of the two, metropolitan students more frequently selected Pollution and Crime as major problems, and less often nominated Traffic Accidents.

Pollution and Crime were seen in much the same light by males and females, but males were more convinced than females that land use was a problem, while females saw Traffic Accidents in a more serious light than males did (39.3% vs. 29.4%).

Table 4.8. Frequency of Response (as %) to Item B10, "Local Problems," by (1) State, (2) School Type, (3) Region, (4) Sex, and (5) Source of Knowledge.

	Pollution A	Crime B	Land Use C	Traffic Accidents D
		State		
NSW	35.8	17.5	14.8	31.9
Qld	24.9	23.4	18.8	32.8
SA	34.9	15.8	15.2	34.0
Tas	34.3	11.4	15.9	38.4
Vic	35.0	24.1	15.5	25.4
WA	28.9	13.1	13.6	44.4
χ^2 (5 df)	30.03*	70.56*	9.05	67.27*
		School Type		
Govt.	32.9	16.6	16.2	34.2
Catholic	28.0	22.5	12.9	36.6
Independent	36.8	17.2	16.1	29.8
χ^2 (2 df)	10.12	15.79*	5.66	4.44
		Region		
Metropolitan	34.5	19.3	14.7	31.5
Non-metropolitan	28.8	14.9	17.3	39.0
χ^2 (1 df corrected)	16.30*	14.42*	5.49	27.35*
		Sex		
Male	34.5	17.8	18.3	29.4
Female	30.2	17.3	13.1	39.3
χ^2 (1 df corrected)	9.47	0.17	22.55*	49.94*
		Source of Knowledge		
General Ed.	33.1	15.7	13.2	38.0
Special	28.1	20.9	12.2	38.8
Media	32.5	18.1	17.4	32.0
Outside Discussion	31.5	19.9	17.1	31.4
χ^2 (3 df)	2.28	8.57	15.11	19.54*

*$p < 0.001$

Alternative D produced the only significant difference between the responses of the four different groups of "Source of Environmental Knowledge" students. Those in the two "In-school" categories believed that Traffic Accidents were more of a problem than did those two groups in the "Out of school" categories.

Comparisons between Item Responses to Corresponding Items by Grade 10 Students in Australia and the USA

Knowledge Section

Twenty-six of the 29 items were comparable. The % correct response to these items for the whole US Grade 10 sample population (N = 6050) is displayed on Figure 4.1, where the symbol x on a histogram represents the US response.

Detailed statistical comparisons are inappropriate since five of the US items offered three alternatives instead of the four which was standard in the Australian instrument. However, if a difference of 10% in the level of correct response given for a particular item is regarded as being worthy of comment, then Australian students scored better on 11 items, US students on 5, and 10 items would be rated equally. Selecting those items where differences as large as 20% occurred, the Australian students knew more than US students about national and global population growth rates, new energy sources, renewable resources and the effectiveness of the automobile as a cause of death. On the other hand, US students were better informed about local water consumption, and about some aspects of atmospheric pollution. The two groups displayed similar extents of knowledge about such matters as world population figures (as against growths), the US use of resources, the main source of phosphate water pollution (a low of about 13% in each case), DDT persistence, and the source and extent of solid wastes and radiation hazards.

Beliefs Section

Figure 4.2 shows the nature of Australian and US responses to the six parallel items in this section.

A large difference of viewpoint existed in Item 9, relating to taxation benefits to parents due to children in the family. Only 9.2% of Australian students agreed with the Panel view that these benefits should decrease, whereas 17.9% of the US students favored such a reduction. On the other hand, Australian students were more inclined to indicate that they would suffer government controls than their US counterparts.

Local Problems

Students in the two countries saw local problems in different ways. Table 4.9 lists the responses for each alternative to Item B10.

Table 4.9. Comparison of Response Frequencies (as %) to Item B10 Alternatives by Australian and USA Grade 10 Students.

	A Pollution	B Crime	C Land Use	D Traffic Accidents
Australia (4713)	32.3	17.6	15.7	34.4
USA (6048)	27.7	27.5	21.7	22.3

For the total sample, Australian students were less concerned about crime and land use than they were about pollution and traffic accidents, while US students showed relatively similar concerns for each, on a nationwide basis.

Analysis of Variance

Table 4.10 lists the means, F ratios and probabilities derived from total knowledge and belief scores.

Knowledge

Significant differences ($p < 0.001$) occurred between males and females ($F = 266.189$), between the four "Source of Information" categories ($F = 34.737$) and also between the three sampling groups used in the second stage sample ($F = 14.508$). The difference between metropolitan and non-metropolitan schools approached that of significance.

Table 4.10. Analysis of Variance, Raw Total Scores, Knowledge and Belief Sections

	Knowledge[a]			Beliefs[b]		
	Mean	F	p less than	Mean	F	p less than
State		1.958	0.082		2.159	0.056
NSW	11.597			11.251		
Qld	11.510			10.983		
SA	11.812			11.196		
Tas	11.895			11.353		
Vi[illegible]	11.708			11.063		
WA	11.840			10.966		
School Type		2.606	0.074		16.211	0.001*
Government	11.709			11.125		
Catholic	11.642			10.876		
Independent	12.106			11.976		
Region		6.244	0.012		13.456	0.001*
Non-metropolitan	11.568			10.982		
Metropolitan	11.819			11.232		
Sex		266.189	0.001*		1.077	0.298
Male	12.441			11.105		
Female	11.036			11.194		
Major Source of Knowledge		36.401	0.001*		23.692	0.001*
Regular courses	11.501			11.011		
Special courses	10.770			10.190		
Reading-media	12.206			11.493		
Outside discussion	11.168			10.711		
Sampling		16.003	0.001*		3.588	0.028
Method A	11.684			11.182		
Method B	12.035			11.221		
Method C	11.363			10.933		

[a] 29 items, scored 1, 0; possible range 0-29.

[b] 9 items, scored 2, 1, 0; possible range 0-18.

$^{*}p < 0.001$

Belief

Significant differences occurred between school types (F = 16.211), Region (F = 13.456) and the "Source of Information" categories (F = 23.692). The large difference observed between the knowledge scores of males and females did not recur in the belief section.

Correlations

The observed correlation values to be described were low, but with such a large number of cases, significant probabilities ($p < 0.001$) occur with Pearson r's as low as 0.05. Two considerations form the basis for reporting a significant correlation between two variables in this section:

1. for an individual item (or category) with another item; if the correlation coefficient is greater than 0.1,
2. for an individual item with a relatively large number of other items; if p in each of the cases is less than 0.001.

Knowledge Items with Knowledge Items

Only two items showed a (correct response) correlation with one another which was greater than 0.1; Item A4 (DDT persistence) with A14 (phosphate pollution), $r = 0.1211$.

Table 4.11 shows the number of times with which particular knowledge items correlated with other knowledge items ($p < 0.001$).

Belief Items with Belief Items
("agree" with "agree")

Item with item correlations were observed with:

Item B1 with B3	$r = 0.1278$
Item B3 with B8	$r = 0.1273$
Item B4 with B6	$r = 0.1053$
Item B5 with B7	$r = 0.1418$
Item B6 with B7	$r = 0.1717$
Item B7 with B8	$r = 0.1132$

Table 4.12 shows the number of items with which particular B items were correlated with other B items. Inter-item correlations of this nature between B items occurred more frequently than those between A items.

Knowledge Items with Belief Items

Table 4.11 also lists the occurrence of correlations ($p < 0.001$) of A items with B items, while Table 4.12 contains a similar listing for B items with A items.

Knowledge items which correlated in this way with at least one-third of the other knowledge items and with at least one-third of the belief items were: A2 (future energy sources); A4 (DDT persistence); A16 (disposal of solid wastes); A23 (population

Table 4.11. Frequency of Positive Correlation ($p < 0.001$) of Knowledge Items with (1) Other Knowledge Items (28), and (2) Belief Items (9).

	Item No. (A)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
With other A items	1	10	1	15	7	3	0	1	1	5	4	7	6	9	7
With other B items	-	5	1	7	1	3	-	-	2	1	-	5	3	2	3

	Item No. (A)													
	16	17	18	19	20	21	22	23	24	25	26	27	28	29
With other A items	12	3	2	2	2	7	9	16	5	15	1	4	5	10
With other B items	6	-	-	-	-	6	4	5	1	3	-	2	2	8

Table 4.12. Frequency of Correlation ($p < 0.001$) of Belief Items with (1) Other Belief Items (8), and (2) Knowledge Items (29).

	Item No. (B)								
	1	2	3	4	5	6	7	8	9
With other B items	5	5	7	8	8	8	6	6	4
With other A items	6	13	8	5	10	8	6	14	1

growths); A25 (oxygen removal from water); and A29 (renewable resources).

Belief items which correlated with at least one-third of the items from each group were: B2 (government anti-pollution controls); B5 (controls in industry); and B8 (nuclear reactor hazards).

"Source of Environmental Knowledge" with (a) Knowledge Items, and (b) Belief Items

The correlation between A4 (DDT) and A30C (media) was 0.1165. In general, this reading-media item correlated more frequently with both knowledge and belief items than any other alternative in Item 30 (Table 4.13).

Table 4.13. Frequency of Correlation ($p < 0.001$) of Item A30 Alternatives with (a) Knowledge Items, and (b) Belief Items.

	Frequencies	
	Knowledge Items (a)	Belief Items (b)
A30A General school courses	2 (-ve)	1 (-ve)
A30B Special courses	1 (-ve)	2 (-ve)
A30C Reading, media	11	5
A30D Outside discussion	2 (-ve)	2 (-ve)

Table 4.14. Correlations (r > 0.1): A Total with B Items.

	Belief Items				
	2	5	6	7	8
Correlation with A total	0.1230	0.1206	0.1167	0.1320	0.1116

Table 4.15. Correlations (r > 0.1): B Total with A Items.

	Knowledge Items								
	2	4	12	15	16	22	23	25	29
Correlation with B Total	0.1228	0.1407	0.1163	0.1062	0.1423	0.1114	0.1467	0.1029	0.1761

Total Scores with Other Variables

Between Knowledge Totals and Belief Totals: $r = 0.2822$.

Between Knowledge Total and Belief Items 1-9,
Belief Total and Knowledge Items 1-29.

Those cases where $r > 0.1$ were extracted. They are listed in Tables 4.14 and 4.15.

Eight Knowledge items (A2, 4, 12, 15, 16, 22, 23, 25, and 29) and five Belief items (B2, 5, 6, 7, and 8) showed such correlations.

Between "Source of Knowledge" and Knowledge Total,
Beliefs Total.

Table 4.16 shows the moderate positive correlation between the "reading and media" source of knowledge and both total scores.

Table 4.16. Correlations: "Source of Knowledge" Responses with Total Scores.

	Knowledge Total	Beliefs Total
A 30A	-0.0579*	-0.0393
A 30B	-0.0679*	-0.0678*
A 30C	0.1401*	0.1093*
A 30D	-0.0789*	-0.0612*

*$p < 0.001$

Factor Analysis

The analysis of correlations for patterns of intercorrelations among the 38 variables in the two sections of the instrument A1-29, B1-9) produced only one factor having an eigen value greater than 1. An examination of the listed residuals for the 38 items as calculated by the FACTOR program showed that 9 of the knowledge items and 7 of the belief items have values of 0.2 or greater, and can be regarded as the major contributors to a "factor." The items were as follows: A2, 4, 12, 15, 16, 22, 23, 25, 29 and B2, 3, 4, 5, 6, 7, 8.

This pattern of items is almost identical to that which emerged from the manual search of correlations ($r > 0.1$) between individual items and the total scores in sections A and B, as reported in the preceding section. The only difference between that set and the set nominated by the factor analysis was that the latter added Belief items 3 and 4.

Alternative Second Stage Sampling Procedures (A, B, C)

Analysis for Differences in Student Responses

An item by item comparison produced only one significant difference in responses to the knowledge items, in item 21, where the random group (C) recorded a low 16% compared with about 23%

for both the other sampling groups. There were no differences in responses to belief items. When mean total scores were examined, a small but statistically significant difference was observed in knowledge total means but not in the means of belief totals (Table 4.10). The lowest means were recorded by the randomly selected Group C.

Summary

The data which have been presented and analyzed in this chapter will be summarized and interpreted in Chapter V.

V. SUMMARY, INTERPRETATIONS, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to summarize the study, to offer interpretations and explanations of particular results where this seems to be needed, to draw conclusions and to make recommendations for further study.

A Summary of the Study

There is a movement in Australia toward the provision of school-based programs in environmental education. As one prelude to such development, the present study was designed to obtain information concerning the current nature of the knowledge and beliefs about environmental matters held by certain Australian students.

A survey instrument prepared and used for a similar purpose in the USA was used in the study, after modification to enhance its suitability for use in Australia. The new instrument contained 40 items in two areas called "knowledge" and "beliefs." One of the 30 items in the knowledge section was designed to trace the major source of student information about the environment, while one of the 10 belief items concerned perceived local problems. Best responses were identified for each of the 29 knowledge items, while a panel provided a common reference point for the nine remaining belief items, so that a composite attitude measure could be obtained. The reference point was that of an attitude favoring the preservation of homo sapiens.

Using the Grade 10 population in the six Australian states as the target group, a two-stage probability sample was developed in which 174 schools identified as the first stage of the sample were each asked to provide 30 students who would then respond to the instrument. These responses were collected and analyzed by appropriate standard computer programs, yielding the following information.

Response by the Schools

A 92% response was achieved. For reasons of practicality, for the second stage sample, the schools were asked to choose the participating students, using one of three designated systems. An analysis of the student responses by sampling groups showed very little difference between them on an item by item basis. However, on a total score basis, a small but statistically significant difference (at the 0.001 level) did exist on knowledge scores but not on composite attitude scores. For practical purposes, the aim of producing a sample of Grade 10 students which was representative of the target population can be said to have been achieved.

Responses by the Students

Before considering the general responses, it should be noted that the responses to item A30 constituted a mini-survey of the extent of environmental education in Australia as seen from the point of view of the students in Grade 10. Only 4.2% of the students claimed that special (i.e. E-E) courses were the major source of their knowledge about the environment. Those students who claimed general reading and the media as their major source tended as a group to more frequently choose the best knowledge response, and to more frequently agree with the panel view than did students who nominated other sources.

Student Responses to the Knowledge Section. The general frequency of "best" responses was not high, for in only 10 of the 29 items did 50% or more of the students select the best alternative among four. The students knew more about population matters than they did about any of the other cognitive areas represented by the instrument. Notable misunderstandings were evident in such areas as the extent and use of resources, pollution sources and their effects, and nuclear radiation.

Differences between stratum groups in item responses were analyzed using χ^2 and AOV procedures. On an item by item basis, χ^2 calculations showed that:

1. There were differences between students according to state of

residence. However, these differences did not occur in a persistent pattern.

2. Little practical difference existed due to membership of a particular school type (i.e. Government, Catholic or Independent).
3. Little significant difference was observed between student responses by region.
4. Males were much more likely than females to give correct responses to the knowledge items.
5. The student group nominating "reading and the media" as their primary source of information gave correct responses more frequently than those students in other self-identified groups.

Analysis of variance procedures applied to group means on total knowledge scores eliminated the differences between states, and confirmed that no practical difference was caused by membership of a particular school type or by living in either a metropolitan or non-metropolitan region. The striking difference between responses by sex was reemphasized. A significant difference was observed between the means of the Source of Information groups with the Reading/Media group having the highest mean.

Student Responses to the Belief Section. A moderately high level of student agreement with the panel responses was observed. In six of the nine items, 50% or more of the students registered agreement with the "preservation of homo-sapiens" position. They were supportive of generalized statements about individual rights and Government controls. However, when specific cases were provided in which these controls could impinge upon individual rights or upon such liberties as the unrestricted use of motor vehicles, individualism tended to assert itself.

When analyses for differences in beliefs between groups on an item by item basis were carried out, it was found that:

1. Little difference was observed by state.
2. Differences between school types became rather more pronounced than they were in the knowledge section. Students from Government and Independent schools, for example, were considerably more favorably inclined to support the idea of population limitation through family planning than were students from Catholic schools.
3. Relatively little difference occurred by region, but non-metropolitan students tended to be less in favor of Government controls.
4. Although male and female responses once again differed significantly in the majority of items, on half of the occasions females agreed more strongly with the panel position than males did. Females were more strongly in favor of family planning, were more inclined to vote for increases in family tax benefits for children, and registered higher agreement

with the proposition that Government environmental protection laws might have to override individual rights. Males were more strongly in favor of specific controls.

5. The "reading and media" group showed a significantly stronger tendency to agree with the panel than members of the other "source of information" groups.

The use of a 2.1.0 scoring method over the nine items placed the responses on a scale arbitrarily marked at one end by individualism and at the other by "preservation of homo sapiens." On this overall basis, students showed a composite attitude favoring that of species preservation.

When total "agree with panel" scores were analyzed for differences between groups, significant differences were found to exist between School Type, Region and Source of Information. There was no difference due to sex on this overall basis, making a striking contrast with the large difference recorded on overall knowledge scores.

Local Problems. Localized differences were evident, with sharper divisions appearing in the vertical strata of State and Region than in horizontal strata such as school type. It seemed that living in an industrialized state or in a metropolitan region increased awareness of pollution, while residence in a less populated situation was related to a higher awareness of traffic accidents.

Correlations. A correlation of 0.28 existed between total knowledge and total belief scores. In view of the large sample size, this is a significant positive value. However, correlations between individual items were low, especially in the knowledge section. One weak factor emerged from a study of intercorrelations among the 39 variables, embracing 8 of the 29 knowledge items and 7 of the 9 belief items. These items spanned all but one of the knowledge areas and excluded only a belief item concerning a very general statement of the rights of "others" and a controversial item dealing with family taxation deductions. Taken together, the 16 isolated items can be taken to represent a set requiring a reasoned and environmentally sympathetic response associated with a good background of information.

USA-Australia Comparison of Student Responses. In view of certain item differences and the fact that not all results from the three Ohio State studies have been released, no examination for statistical relationships due to country of residence were made. However, a general examination of "best" responses to corresponding items showed that both groups revealed a reasonably strong and general attitude toward environmental conservation. On the basis of this instrument, the Australian students appear to possess at least as much environmental knowledge as their counterparts in the USA, but in both cases severe knowledge deficiencies or misunderstandings were revealed. In both countries, similar effects were noted as the result of membership of a particular sex. In particular, males scored higher than females on matters concerning environmental knowledge.

This summary of the results of the study is concluded by Table 5.1, which relates the findings to the hypotheses stated in Chapter I, p. 15. Total scores together with 0.001 confidence levels have been used.

Table 5.1. Rejection of H_0, Total Score Basis.

	Knowledge	Attitude
State	not rejected	not rejected
School type	not rejected	rejected
Region	not rejected	rejected
Sex	rejected	not rejected
"Source of Information"	rejected	rejected

Some Interpretations and Explanations of Individual Results

Differences Associated with Sampling Method

Secondary school class groupings in Australia have tended to be more homogeneous than heterogeneous, with both "streaming" and "tracking" practices being common. While it was hoped that schools would choose to select the second stage sample (the students) by method C, the random process, it was inevitable that some schools would use existing classes, and that in doing so some relatively homogeneous groups would be used. It is reasonable to expect that schools would not choose the "worst" non-heterogeneous class available, and in these circumstances it is not surprising that sample group B contains students who scored more highly than other student sample groups, on the knowledge section at least. As the randomly selected students obtained the lowest mean knowledge score of the three groups, it must be accepted that the likelihood exists that the "true" total knowledge level of the Grade 10 population with respect to the instrument used is slightly lower than that indicated by this study. While the attitude mean scores for the three groups were ranked in the same order as in the knowledge section, the statistical (and hence practical) difference between them disappeared. That is to say, the environmental attitude revealed by the study is indicated as being that of the Australian Grade 10 population. If selection by academic merit is proposed as the cause of the somewhat higher knowledge scores of the Sample B students, then it seems that other effects intrude in the development of environmental attitude.

The "Source of Information" Item, A30

Although this seems to be a fruitful item, some caution is warranted during the interpretation of the responses. While it is evident that Grade 10 students have not perceived special school courses as their major source of environmental information, this is not to say that schools have not been providing environmentally oriented material during other courses of study. However, any such activity is not yet being seen by students as providing the major source of information. It seems reasonable to hope that even a well-conceived trans-disciplinary approach to E-E would not disguise itself so completely that students would not be aware that the composite effect was to provide an environmental education.

Those students who nominated reading and the media as their major information source scored higher than other students on both knowledge and attitude measures. Perhaps this item has allowed these students to reveal themselves as those who generally read and use the media extensively. Perhaps they have simply added this extra information source to what has already been provided in school. However, no matter what might be the implications of the item responses concerning the state of environmental education in the schools, the findings suggest that media sources do influence environmental knowledge, and perhaps attitudes. Efforts could be made to improve the coverage given to such matters by the media, for Linke (1974b) has shown that at present the environmental content of the media is both limited and directed toward topical issues with political significance.

The fact that those few students who nominated special courses in school as their major information source fared relatively poorly on both measures can hopefully be disregarded. The distribution of these students in ones and twos over almost the whole range of schools suggests that they have simply recalled an environmentally related topic in some regular school subject, and have nominated it as a special course. The one block of students who did nominate this alternative happened to be from a Catholic school. In such a small overall response this one group was probably responsible for the appearance of a significant difference between school types on this item alternative. Such a result could be regarded as spurious. However, this rather curious effect could serve as a useful reminder that courses in E-E could become so specific in relation to a particular aspect of the environment that they made little contribution to an overall and desirable state of "environmental literacy."

Differences Associated with Sex

In terms of magnitude, differences due to sex accounted for more of the observed variation in responses than any other variable. The measured environmental knowledge of the males was higher than that of the females, but there was no difference in total attitude score. A similar knowledge pattern was observed in

Perkes' (1973) study in the USA, while the 1975 report of the National Assessment of Science, 1969-1973 shows that in the USA the average performance of 13-year-old and 17-year-old males is respectively 4% and 6% above that of females.[5] Such a generally poorer performance of females at the secondary level might be due to a decline in motivation brought about by their view of the role of females in society. The responses to item A30 in this study suggest that males read and attend to media presentations more extensively than do females, an effect which may be related to such a motivation theory. At any event, if Australian schools are not tending to provide E-E programs, and females do not tend to utilize outside sources, then the superiority of males as far as environmental knowledge is concerned becomes more understandable.

While there were differences between males and females on individual attitude items, their overall attitude scores were similar. It may be that this particular instrument allowed differences between males and females to sum to zero, and that generalizable differences exist but were not detected. However, it may also be that environmental attitudes are not generated solely by the traditionally accepted means of information input in the content sense, but by other processes associated with the development of basic value patterns.

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[5] Science report 04-S-00 of the Education Commission of the States, Feb. 1975. p. 10.

Differences Associated with State of Residence

Although there were no significant differences in knowledge and attitude means, the series of sharp differences observed in separate items suggests that local influences are operating. The state-wide similarity in educational programs and text book use, together with an emphasis on local rather than global issues in media presentations could account for these effects. That they tended to cancel one another out is an indicator that in no state more than another are concerted E-E efforts being made.

Differences Associated with School Type

The higher mean attitude score of students from the Independent schools is interesting in view of the high socio-economic level normally associated with the population of these schools. Relationships between socio-economic status and success in various educational activities have been clearly demonstrated by numerous studies. Is an environmentally conservative attitude also related with socio-economic status ?

Conclusions

A considerable amount of detailed information concerning areas of environmental knowledge and ignorance, and relating to beliefs and attitudes about environmental issues in Australia has been accumulated through this study. While interesting differences exist between sample groups, the overall environmental knowledge revealed by the study is low. It does seem that there is cause for concern about this low level of information. When, for example, 13 years after Rachel Carson and her Silent Spring, some 36% of Australian students (and US students, too) believe that DDT is active for only a few weeks; when over 20% think that atmospheric inversions actually produce pollutant particles; when some important national resources are grossly over-estimated and "industry" tends to appear as a scapegoat for pollution effects really caused by the population at large, then a good case can be made for E-E programs which will have the imparting of environmental knowledge as a major goal. This lack of environmental information is not unique to Australian students, however. In all relevant USA studies reviewed for Chapter II, student knowledge scores were low.

The collected responses indicate that (as far as this instrument shows) the attitude of Australian students to generalized environmental conservation issues is quite positive. However, the responses to several of the Belief items (e.g. concerning restrictions on the personal use of automobiles) suggests that such a general attitude may prove to be fragile when confronted with immediate personal needs. This tendency for students to verbalize positive general attitudes toward environmental conservation, while revealing that such attitudes may not persist if individual self-interest is threatened was clearly revealed in a number of the studies reviewed in Chapter II. Nonetheless, the general response suggests that these Australian students might, as voting (18-year-old) adults in two to three years time, support or at least endure determined legislation directed at environmental conservation.

The matter of whether or not specific information about aspects of the environment is the direct causal agent of attitudes relating to environmental conservation has not been clarified by this study. There was a moderate correlation between knowledge and attitude scores. But while responses to the knowledge section were relatively (if understandably) poor, the responses to the Beliefs section were notably "good," if "good" can be taken to mean either agreement with the panel or, at least, a failure to reject that view of the beliefs associated with the preservation of homo-sapiens. Slesnick (1971), writing as a prominent environmental educator with special interests in population education, observed that "new attitudes which will change reproductive behaviors can occur through the formal schooling of children in a program of population education." By responding so positively to item B6, it might be argued that most Australian students have (on paper at least) the kind of attitude to which Slesnick refers. Further, it seems that these students have acquired this (and other) "desirable" attitude without a great deal of general exposure to deliberate school-based E-E courses. What then would be the goals of new E-E course units on population control, if entry attitudes are already so positive?

Other, less direct ends have also been achieved by this study. The indirect survey of the extent of E-E (from Item A30) provided considerable information and scope for speculation. The reasons for the extraordinarily high response to the study by Australian schools should also be considered. While this response may reflect upon the success of the survey design and the data collection procedures, the every-day experiences of this Australian educator have shown that school administrators have natural and reasonable reservations about using up school time to help researchers, especially those who are far away. The magnitude and promptness of the response on this occasion really seems to provide another finding for the study. It suggests that Australian schools are ready and perhaps eager to become involved in environmental education activities, and to secure information which might be directly useful for that purpose.

Generally, the results of this study are indicative of a task facing school and society in environmental education. A situation has been revealed in which relatively embryonic E-E activities in Australia have "produced" a verbalized conservation attitude which appears to be positive. Yet this attitude appears to have been established upon what is--by the measure of the instrument used for this study at least--a poor information base. Remembering that environmentally conservative behavior is surely the real goal of E-E, one must question the stability of such attitudes in conflict situations.

Wicker's analysis (1969) of attitude-behavior studies, and in particular the set of criteria which he used in selecting studies for his analysis, is of relevance to E-E and the problem posed by the results of this study, even if the research he reviewed was in other fields. In E-E, educators are invariably in the situation wherein to measure the success of their efforts they will turn, in part, to attitude measures of some kind. They will then usually obtain generalized verbal statements from which it will be inferred (and hoped) that specific behaviors will follow at a later time. Wicker's review indicates that such hopes are not well grounded.

The Fishbein and Ajzen conceptualization of the belief-attitude-intention-behavior web gives some insight suggesting why such straightforward and simple hopes do not tend to be fulfilled. These writers state that information is always at the base of attitude formation or change. However, they do not use "information" in a simplistic sense. Perhaps educators--of whom this researcher is one--do. There seems to be a tendency for educators to use an "information upwards" approach. One provides information (say) on the deleterious environmental effects of motor vehicles. One hopes that student attitudes will thereupon be formed which will favor the decreased use of such vehicles, and (say) the increased use of mass transit systems. Yet, even the simple form of instrument used in this study showed that such an information-attitude relation is not well grounded. What other information is needed then?

Bruvold (1973) provides some thoughtful suggestions. He noted that certain environmentally oriented behaviors were able to influence attitudes, quite independently of the beliefs which his subjects held. This is not to say that information has not been active again, for the Fishbein and Ajzen model would propose that information about the effect of the behavior concerning the object had modified those beliefs which contribute to the degree of affect (the attitude) toward that object. But the Bruvold diadic model offers some practical suggestions for what schools might incorporate in their E-E programs. The inflow of information--in its broad sense--needs to be strengthened from as many aspects as possible. The traditional procedures followed by teachers certainly need to be pursued vigorously, for this study suggests that many students are barely literate in the environmental sense. They need to have an information bank to which attitudes toward objects can be referred. But they also need, it seems, experiential information about the effect on the environment of certain behaviors. This is not a suggestion that E-E should become a sort of outdoor education, although there is clearly a place for that kind of educational experience. But behavior which can lead to positive attitudes might be able to be provided in school settings. For example, requiring students (and perhaps teachers) to use public transit systems, at the same time ensuring that such experiences are fruitful, might be more useful in developing attitudes (or more particularly firm intentions) to use such transportation methods as much as possible, than any "normal" information on the hazards associated with the use of many individual automobiles.

Recommendations for Further Study

If environmental education has the importance which its protagonists claim, then few things could be as important to the national interest as a well-based evaluation program designed to monitor the outcomes of the new E-E activities. The Australian schools, by their ready participation in this study, have demonstrated their interest in such nationwide evaluative activities. This research has shown that information of this nature can be collected readily. Therefore, it would seem prudent to establish a regular and sympathetically comprehensive evaluation program, either as an entity of its own, or as part of the newly proposed National

Environmental Education Project. A fundamental question is "What is to be evaluated?" A characteristic of discussions about the environment and environmental education, as shown by Lucas (1973) is their ambiguity and lack of clarity, even in the use of the most fundamental terms. The lack of a clear model for E-E naturally hampers the development of broadly based evaluation instruments such as the one used for this study. If in the new Australian E-E project, a model such as that proposed by Lucas and again by Linke (1974) is used for curriculum development, then an accurately focused instrument could become a reality. Some specific suggestions for the preparation of the instrument include:

1. There is a need to relate the instrument to the stated and accepted goals for E-E which will or should emerge from the proposed National Environmental Education Project.
2. Items should be constructed in such a way that they have diagnostic capabilities which can be readily related to possible modifications in teaching/learning practices. The experience gained in the construction of such items by the ACER during its preparation of diagnostic instruments for high school science subjects should be utilized.
3. The addition of an "I don't know" alternative to the standard four alternatives found in the multiple choice questions should be considered. The student responses to a rather similar

alternative in the Beliefs section of the present instrument indicate that the students would not use such an alternative flippantly. Used in appropriate circumstances, such an alternative tends to clear out the guessing element from among the other responses, increasing the diagnostic utility of the instrument.

4. Refinements could be made to the method of distinguishing between metropolitan and non-metropolitan, or urban and rural students. In this study, the distinction was rather coarse, and the data will be reworked using the 1971 general census information now available. In a new study, information about community size could be collected at the time when the instrument is used in the schools, as was done in the Ohio State studies.

One puzzling aspect of all school-based E-E programs and one which relates to the proper evaluation of the effectiveness of these programs seems relevant for discussion here. The view can be taken that the real and ultimate goal of E-E must be the alleviation of those environmental concerns which produced the need for those E-E programs in the first place. Since these concerns spring from the realization of the damaging effects of current human practices, then it is these practices which need to be modified. Thus the eventual concern of an effective E-E program must be to cause (or help cause) substantial changes in human behavior. Seen from this viewpoint, the most appropriate evaluation of E-E programs, especially terminal ones, would be a monitoring of the behavior changes which the programs produced. While it is of interest to evaluate knowledge and attitude positions, they are, after all, somewhat peripheral. But it is a dilemma of E-E programs that their participants (young people) are generally not in a social or economic position which permits them to demonstrate that they have attained the ultimate goals of the programs. School-age students are not yet population-producers, significant consumers possessing the capability to change harmful practices, nor yet voters able to influence legislators. In this context, realistic evaluation of environmental education activities by any of the common practices available to educators is difficult indeed. However, given the importance of bringing about changes in current human activities in respect of the environment, a proper direction for future research would seem to be that of attempting to identify those student behaviors which can be shown to be consistent with subsequent and "desirable" adult behavior toward the environment, and to develop those evaluation measures which could measure these behaviors.

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APPENDIX I

The next two pages contain a photo-reduced version of the instrument. The actual document measured 8 x 13 1/2 inches, printed both sides. Perforations allowed the removal of the response section for economical mailing.

Section A

KNOWLEDGE

Items 1-30 concern knowledge about the environment. In each case, select the one response which provides the best answer. Enter the letter A, B, C or D of that response in the Answer column on the right.

1 The population of Australia is growing at a rate which is
A less than that of the world average
B about the same as the world average
C more than that of the world average
D zero

2 Which of these has been shown to be the most likely world-wide source of energy for the future?
A solar radiation
B tidal flow
C geothermal sources
D wind power

3 Most of the nuclear radiation to which people in this country are exposed is due to
A the normal hazards of work
B TV sets and luminous watches
C medical sources (X-rays, etc)
D natural sources

4 Once DDT has been spread to kill pests, it
A remains active for a few weeks only
B remains active for one or two years
C remains active for many years
D remains active for ever

5 At today's rate of use, known world reserves of resources such as zinc, lead, tin, oil and copper will be used up, or will be at a very low level in about
A 10 years C 100 years
B 50 years D 200 years

6 The major cause of death in the 18-24 age group in Australia is
A suicide
B motor car accidents
C sickness and disease
D drugs

7 If, from today, no migrants came and all new families were to have no more than two children, the population of this country would
A rise at first, but would level off
B remain at its present level
C slowly fall
D keep rising

8 The rate at which Australians are taking water from underground sources is
A not accurately known
B less than the replacement rate
C about equal to replacement rate
D more than the replacement rate

9 Air pollution due to solids (soot, dust etc) tends to
A increase the earth's temperature
B decrease the earth's temperature
C keep the earth's temperature steady
D have no effect on the temperature

10 The major air pollutant (as measured by weight) discharged into the air is
A nitrogen oxides
B sulphur oxides
C carbon oxides
D solid particles

11 The largest single source of manmade radiation to which Australians are exposed is due to
A the fallout from bomb tests
B nuclear power-plant radiation
C TV sets and luminous watches
D medical sources

12 By law, who can ban the sale of polluted food to the public?
A the Federal Government
B each State Government
C those who grow or process the food
D one or more trade unions

13 The chief source of solid wastes is
A factories
B private homes and flats
C offices and shops
D agriculture

14 Most of the phosphates which reach the oceans come from
A Local Council drains
B industrial sources
C farms
D boats

15 An inversion can be harmful because it
A puts more carbon dioxide into the air
B keeps pollution near the ground
C cuts down on horizontal air flow
D produces pollutant particles

16 At present, the cheapest way to dispose of solid wastes collected by Local Councils is
A incineration
B recycling
C dumping in pits and covering with soil
D composting

17 The average use of water per head per day in this country is about
A 10 gallons C 100 gallons
B 50 gallons D 200 gallons

18 The population of the world increased from 2 thousand million in 1930 to about
A 2.5 thousand million by 1970
B 3.0 thousand million by 1970
C 3.5 thousand million by 1970
D 4.0 thousand million by 1970

19 The United States has about 6% of the world's people. Of all the non-renewable raw materials processed in the world each day, what fraction does the US use?
A 5% C 25%
B 10% D 50%

20 The known supply of natural gas in Australia is now estimated to be enough to provide for local use for about
A 15 years C 50 years
B 25 years D 100 years

Now turn the page

ANSWERS for A 1-20

Your sex? (M or F) .....

A1 ....
A2 ....
A3 ....
A4 ....
A5 ....
A6 ....
A7 ....
A8 ....
A9 ....
A10 ....
A11 ....
A12 ....
A13 ....
A14 ....
A15 ....
A16 ....
A17 ....
A18 ....
A19 ....
A20 ....

Now turn the page

Section A (cont)

21 What fraction of the people in Australia lives in urban areas?
A about 30% C about 70%
B about 50% D about 90%

22 These gases may be found in polluted air. Which is the most corrosive?
A carbon dioxide
B sulphur dioxide
C carbon monoxide
D ammonia

23 Populations are growing fastest in
A highly industrialized countries
B countries just becoming industrialized
C underdeveloped countries
D agricultural countries

24 In 1920, the amount of garbage picked up by Local Councils in Australia was probably less than 2lb/person/week. It is now about
A 1.5lb/person/week
B 2lb/person/week
C 5lb/person/week
D 10lb/person/week

25 Many organic wastes are broken down in water. In the process, what substance is taken out of the water?
A carbon dioxide C hydrogen
B oxygen D sulphur

26 Which of these cuases most of the thermal (heat) pollution of water
A electric power industry
B rubber and plastic industry
C textile industry
D paper industry

27 What fraction of the private dwellings in Australia is served by public sewers?
A more than 90%
B about 70%
C about 50%
D less than 30%

28 The greatest amount of air pollution in developed countries comes from
A cars, buses, trains, planes etc
B industry
C burning solid wastes
D homes

29 Which of these resources can be renewed?
A wood and paper
B distinct species of animals
C fossil fuels (eg, coal, oil)
D minerals

30 Say which of these best describes the way in which you have gained most of your knowledge about the environment
A your general education at school
B special courses at school
C your private reading, the radio, TV etc
D talking with parents, friends and other people

Go on to Section B

Section B

YOUR BELIEFS

The next ten items concern your environmental beliefs. There are no 'best answers'. The responses needed for items 1-8 are:

A 'agree' – if your own belief agrees closely with the statement given

B 'neutral' – if you believe that arguments supporting the statement are balanced by those which do not support it

C 'disagree' – if your belief does not coincide with the statement given

D 'no opinion' – if you have no considered viewpoint, or if the matter does not interest you

1 People must appreciate and respect the rights of others
A agree C disagree
B neutral D no opinion

2 Only strong controls by Government will reduce pollution problems
A agree C disagree
B neutral D no opinion

3 There is no need to worry about pollution or population problems because Science will solve these problems before they become too serious.
A agree C disagree
B neutral D no opinion

4 It is more important to pres[illegible] the freedom of a person's choice than to enforce laws to protect the quality of life in the future
A agree C disagree
B neutral D no opinion

5 Controls should be placed on industry so as to protect the environment, even if this means things will cost more
A agree C disagree
B neutral D no opinion

6 Planning which will limit the size of families is important if over population is to be avoided, and a reasonable standard of living ensured for people in the future
A agree C disagree
B neutral D no opinion

7 The people of this country should be allowed to use motor cars as much as they wish
A agree C disagree
B neutral D no opinion

8 When the coal or natural gas fuel for power stations runs out, it will be vital to produce electricity from nuclear reactors, no matter what the radiation hazards are
A agree C disagree
B neutral D no opinion

In questions 9 and 10 show which answer best represents your viewpoint.

9 A parent can now claim (deduct) $208 or more from his or her taxable income for each child under a certain age in the family. Would you vote to
A increase the tax claim per child?
B leave the tax claim per child as it is?
C decrease the tax claim per child?

10 Which of these problems do you think is the most serious in your community at present?
A pollution C land use
B crime D traffic accidents

ANSWERS (contd)

A21 ....
A22 ....
A23 ....
A24 ....
A25 ....
A26 ....
A27 ....
A28 ....
A29 ....
A30 ....

SECTION B

B1 ....
B2 ....
B3 ....
B4 ....
B5 ....
B6 ....
B7 ....
B8 ....
B9 ....
B10 ....

APPENDIX II

Photo-reduced copies of data collection material sent to schools.

(1) Letter to principal

(2) Administrative suggestions

All communications to be addressed to the Director-General of Education

In reply refer to

....

Name..

Phone.........................Extn...........

EDUCATION DEPARTMENT SOUTH AUSTRALIA

BOX 1152, G.P.O., ADELAIDE, S.A. 5001
TELEGRAPHIC CODE—EDUC ADELAIDE

ENVIRONMENTAL EDUCATION PROJECT

You will be aware of the current interest in Environmental Education, for many schools and curriculum groups are working on new courses and materials. As a former Science Consultant and now Senior Education Officer with the South Australian Education Department, I am in the middle of a preliminary study prior to some curriculum development in the area. Early work has shown that it is important to obtain Australia-wide information, so I am approaching you to ask if your school can help. In exchange for such professional assistance, I am happy to be able to offer you and your teachers some useful student materials and comparative information.

The study is described more fully on the sheet attached, but briefly, I am trying to find out what students already know and believe about environmental matters. It is important to have this information before constructing new courses, yet my investigations have shown that there has been no Australian survey to discover it. For the study, a short interesting 'test', (lasting 25 minutes) has been developed, to be taken by Grade 10 students. In each selected school, a group of about 30 students is being asked to take part. I would like to ask if your school will join in, and stress that this is not an achievement test in any sense of the term.

Since your school has been selected as one of those to be approached, your co-operation can make an important contribution to the development of future courses. But in addition, I believe that there should be a more immediate return to co-operating schools, and can offer you the following things -

- Please keep the enclosed sheets for the school's own use with other students. (The answer section to be filled in by the students in the present study is perforated for easy removal before mailing back to me).

- The exercise has value in its own right, for the items interest students, and provide many focal points for subsequent discussion or investigation in Science, Social Studies or English classes.

- The reading level of the items is precisely at the Grade 10 level, making it useful as a reference point for other materials. (If it would be useful to you I would be happy to send some information showing how the readability was measured, and how the original trial forms were altered to bring the reading level down from Grade 13 to Grade 10).

- When the general responses from the schools are in, a copy of the 'best answers' for the knowledge section of the test will be sent to you. There are, of course no 'best answers' for the beliefs section.

- At the end of the whole study, if you desire it, I will extract and summarize the results from your school so that you can compare them with the general data. I should emphasize that this forms no part of the study, and the information will be confidential to you. But I know it will be of great interest and use, and will be glad to undertake this work for you.

The necessary materials are enclosed with this letter. They are self contained, and a return envelope and postage for the response sections is attached. Suggestions for selecting the students are included.

The matter of any co-operation is entirely yours to decide, of course, but I have naturally described the Project to your State Director-General of Education, and have his approval in making this approach to you.

Since it is best if students undertake the test at about the same time, it would be most helpful to me if the answers were to reach me by the end of October. I look forward to the responses from your students, and to contacting you again with the summaries and more information later. Please write if there is any other information which you need.

Yours sincerely.

Vivian Eyers,
Senior Education Officer,
Education Department of South Australia.

A SURVEY OF KNOWLEDGE AND BELIEFS ABOUT ENVIRONMENTAL EDUCATION

A GENERAL DESCRIPTION OF THE SURVEY

In order to provide basic working information for curriculum work in Environmental Education, this survey sets out to find what kind of knowledge and beliefs students already have about matters to do with the environment.

The design of the study is meant to provide for its use in a practical educational situation. It is simple, very easy to administer, yet well enough designed to allow well-based inferences to be made. It is directed toward students at the end of their tenth year of schooling, since this stage most clearly defines the end of the "general" education provided in most Australian school systems.

THE INSTRUMENT

The basis of the study is a set of 40 multiple-choice items, divided into two sections. The first deals with some of the "common knowledge" about the environment, covering such matters as the extent and use of resources, nature and causes of pollution, population growths etc. The second is concerned with the student beliefs about some of the issues raised by these matters - e.g. about whether Government controls are necessary to control pollution etc. The sets of items are related to one another in various ways. It is in no sense an achievement test.

The set is related to, but differs from one developed for use in the U.S.A., by the Science Education Department of the Ohio State University.

In addition, the set is meant to be good enough so that it is worth using in its own right, even if no survey were being undertaken. The questions are interesting, and local trials have shown that they provide a good basis for subsequent class discussion and investigation. In other words, it makes a good lesson basis in itself. The reading level has been adjusted so that it is at the Grade 10 level.

SAMPLING

A two-stage sampling scheme has been devised with the assistance of the ACER. Since groups of students are involved, correlations within each class can be expected to be high. Thus a relatively large number of schools must be included in the sample. In all, some 174 schools throughout Australia are being asked to take part, using about 30 students in each school. The sample contains a population-based weighting involving each of the three major school systems - Government, Catholic and Independant.

A SURVEY OF KNOWLEDGE AND BELIEFS ABOUT ENVIRONMENTAL EDUCATION

USING THE SURVEY WITHIN THE SCHOOL

The following things have been borne in mind, so that the instrument will be really easy to use without disrupting the normal school situation.

(1)A sample size of up to 35 students is used, so that a full class group can be involved.

(2)The whole operation is easily performed within one lesson period, and virtually no administrative functions are required.

(3)The "test" and its answer section are contained on a single sheet of paper, to minimize distribution time.

If need be, the survey could easily be given to a class by a "relief" teacher or a teacher aide, during the absence of one of the regular Grade 10 teachers.

After the decision to use the survey, three steps are involved -

STEP 1 - CHOOSING THE STUDENT GROUP

Select the most heterogeneous group available in the school at the Grade 10 level. One of three methods seems feasible -

SAMPLE METHOD A: If the school has already grouped its students in a truly heterogeneous way, then simply use any one of those groups. (It is not necessary to use a science class).

SAMPLE METHOD B: If method A is not applicable, simply select the most heterogeneous group available. e.g. in some schools, the English classes tend to be more heterogeneously distributed than (say) Maths or French.

SAMPLE METHOD C: If the school is prepared to do so, select the group of students by a random procedure. Here is one method -

1. Take an alphabetized list of the students, and number them (say 123).
2. Decide on the number to undertake the survey (say 30).
3. Find the "sampling interval" by division (e.g. 123/30 = 4). Round off.
4. Randomly choose a number in the range 1-9. Let this be the number of the first student selected (say 3).
5. Add the interval number to this first number successively until the list is used up. (e.g. 3,7,11, . . . 119). If only 29 numbers are produced, start at the top again, carrying through any remainder.

Please indicate which of methods A B C was used, on the return envelope provided.

STEP 2 - GIVING THE "TEST"

When the class is ready, give out the survey sheets. Perhaps a few words like these could be said - "Here is a set of questions about our environment. Write your answers in the column on the right. Notice that there are questions on both sides. They will take you about 25 minutes, but it is not a race. Think carefully."

At the end of the time, pick up the complete sheets. **Separate the answer section by pulling it away at the perforations.**

STEP 3 - MAILING BACK THE RESPONSES

Drop the answer slips in the stamped addressed envelope provided. Mark the information panel with - number of answer slips enclosed, sampling method, and whether you wish to have a confidential summary of the school's answers sent to you. If you would like the readability information, please indicate this too.

Thank you very much indeed.

APPENDIX III

The "Preservation of homo sapiens" Scale

Panel Members

Dr. Arthur Lucas	Lecturer in Science Education Flinders University
Dr. Peter Davis	Reader in Medical Biology University of Adelaide
Dr. Effie Best	Senior Research Officer Education Dept. of South Australia
Glen Chittleborough	Lecturer in Science Methods Adelaide College of Advanced Education
Lester Russell	Senior Education Officer Education Dept. of South Australia
David George	Senior Education Officer Education Dept. of South Australia
John Smith	Consultant, Biology and Outdoor Education Education Dept. of South Australia

Terms of Reference

The panel members were asked to respond to Section B of the Instrument, Items 1-9, from a point of view which each considered would be consistent with the preservation of the species homo sapiens. The results are listed below. It should be emphasized that these responses do not therefore necessarily represent the personal attitude positions of the panel members to those items.

Responses by the Panel

	Responses				Key
Item	A	B	C	D	Adopted
B1	7				A
2	5	2			A
3			5/5[a]		C
4		1	6		C
5	6	1			A
6	7				A
7		1	6		C
8			7		C
9		2	5		C

[a] New item, substituted after lack of substantial agreement with original item B3. Only five panel members responded.

The "agree with panel" key for the student responses was therefore taken to be that listed above.